ESSAYES OF ANATOMY

In which the Construction of the

ORGANS

AND THEIR

MECHANICAL OPERATIONS,

Are clearly Explained according to the new

HYPOTHESES.

By * * * * * * Dr. in Medicine.

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TO THE
IGHT HONOURABLE
The VISCOUNT of
TARBET.

My LORD,

THe following Treatise receiving the Approbation of a most Ingenious Peice, it has encouraged the making and publishing this Translation, to supply the scarcity of French *Copies, and to satisfy the Curious, who do not understand that Language. And because the Author of the* Essayes

have both the Honour of Your Lordships Acquaintance, and also the Favour of Your good Opinion. Therefore Your Lordships Patronage and Protection, is Humbly desired to this Translation, which will be found a true though Representation of the Author Thoughts and Sentiments. And the Publisher hath presumed to prefix Your Lordships Name to this, that He may testify his Duty to Your Lordship, and likewise because of Your Lordships readiness to encourage all Ingenious Studies and Enterprises.

I

The STATIONERS ADVERTISMENT TO THE READER

THose who Judge of a Book by the Title, are Discouraged when a Title is Simple; and on the contrary, believe that a Work is Excellent, when Men have the Art to give a great *Idæa* of it, by an ingeniously invented Title; we might doubt of their acceptance of this little Treatise, if many others which have appeared with the same Modesty, and have nevertheless had a great Success, had not favourably disposed the Reader for the word *Essayes*. Since those of the Famous *Montaigne*, how many others have appeared in *Physick* and in *Morality*,

which have been the Admiration of all the Learned? I hope therefore that they will not be prejudiced against this present Treatise, because it promiseth nothing but *Essays*, and that they will have the Patience to see what it sayes. After which I am perswaded they will be satisfied. I shall say no more to recommend my Marchandize.

THE PREFACE.

THE knowledge of the Living Body is extremly necessary for Physicians. Without it they do nothing but at adventure. This is a Flambeau which gives them Light in the Causes of Diseases, and in the Choice of Remedies. And all they who understand nothing in it, can be reasonably concluded no other then Charletons.

The most part of Judicious and Ingenious Men have alwayes acknowledged this Truth. It is for this that they have ever cultivated Anatomy with much application. In the past Ages they thought they knew all that could be Learned of it. And

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in this, they have found, to the shame of Physicians, *that they have made but a very small advance in this* Science.

The preoccupation in which they were in past Ages in favour of the Antients, was the Cause why they did not apply themselves to Learn: but when these had discovered Hippocrates *and* Galen *only were then studied. They sought in their* Writings, *all that they were obliged to know, to render them* Learned Men. *They imagined they knew all, and took those for* Visionairs, *who pretended to know more than these. Thus the past* Ages *have been extremely barren in* Discoveries.

But, Thanks to the Penetration *of an excellent* Philosopher *of this* Age, *it has been discovered that the* Living Body *is nothing but a* Machine. *Men have applied their Minds to discover its* Springs. *In this* Harvey *and* Pecquet *have been successful. The* Circulation *of the* Blood *has Immortaliz'd the one, and the Reservatory of the* Chyle *and the* Thoracick

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Conduit, has given the other a Reputation, which will never end.

Their Example has animated all the Anatomists. They found they had made small progress in the knowledge of this Machine. They were perswaded that they needed but search to make Discoveries. In effect the Bartholin's, the Wharton's, the Steno's, the Willis's, the Glisson's, the Lower's, the des Graaf's, &c. And above all the Malphigis have searched very deep into the Structure of the Living Body. The Discoveries which they have made do give us an Idea of an Animal, altogether different from what the Antients had of it.

It might seem that after them, there remained nothing to be Discovered. Nevertheless there are Treatises frequently published, which contain some new thing, and I doubt not but an hundred years hence they may make some new Discovery.

The Contrivance of the Body, is necessary for explaining the Office and Function of its Parts; and if what we fancy to be the Contrivance, is not sufficient for

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the Explication of the Operations *of the* Body, *nor the* Effects *of its* Particular Members *and* Parts, *we may therefore conclude that there is something of this* Contrivance *yet to be* Discovered. *The best* Anatomists *do ingenuously acknowledge, that they fail in many* Particulars; *there are therefore many* Discoveries *yet to be made.*

Some of them will be found in these Essays; *and to me they seem* Important *enough to make me believe that they will not be unacceptable. I do not conceive the same hopes of my* Sentiments, *concerning the nature and use of the* Liquors *which are found in the* Living Body. *To those who are prejudiced, the Novelty of the most part of them, will make them seem extravagant. But I hope those who do not condemn an Opinion, without having examined it, will do me the favour to believe, that if they find them Erroneous, I was not hastily mistaken without good and probable inducements.*

I shall only beg of them to Read the first Treatise *of these* Essays, *before they read*

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the rest. It gives the Idea which I make to my self of the Elements, that without it they will not conceive so distinctly what is treated of in the rest.

There is a great Connexion between all the Treatises of these Essays. Those who would understand them well, will not do ill to read them in Order. The Order which I give them will seem Fantastical to those who are accustomed to read Courses of Anatomy written according to the Ordinary Method. But they who shall observe that each Treatise serveth for the understanding of that which followeth, will acknowledge that I have given them a Natural Order.

Perhaps it may be thought strange, that I make no mention of Authors in the places where I set down their Discoveries. They may even think that I do it on Design, to attribute to my self the Glory of them. In this they would do me a great Injury. I am not so base as to acquire Reputation at the Expence of that of others. But I have not nam'd those who have made the Discoveries,

series, because every Body knows them; and it would serve nothing for the understanding of these Essays.

There is an excellent Anatomist at Montpellier, who is called Monsieur Chirac. The first reason which has made me waive the Names of others, has no place as to him. Nevertheless I have not Nam'd him any where. But I'le do him Justice here. It is he who has written to me, that all the Glandules were nothing but heaps of Circumvolutions of Vessels; after which I have told him, That by chance I have observed something like to this in the Prostates of a Dog.

Moreover almost all Authors do place their Names at the Frontispiece of their Works. This probably flows from the good Opinion that every one has of his own Productions. Every Body is fond of them. There is scarce a silly Scribler, who does not imagine that his Work has something of Transcendent in it. Though for the most part it is nothing but a Mutilation of good Authors.

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By this you may know the reason why I do not as others. I have not a good enough Opinion of this Work to imagine that it will do me a great Honour. Besides I Write but to expose my Thoughts *to others, to the end, that if they be wrong, they may Correct them, and if they be just, they may help forward to better.*

ESSAYES

The PREFACE.

By this you may know the reason why I do not use Preface: I have not a good enough Opinion of this Work to imagine that it will do me a great Honour. Besides I write but to expose my Thoughts to Others, to the end, that if they be wrong, they may Correct them, and if they be right, they may help forward to others.

ESSAYS OF ANATOMY.

The first Discourse. *Of the Elements of a Living Body.*

Sect. I. *Of the first Elements.*

THe *Idea* that we have of Matter and Motion, leads us to think, that all Bodies are composed of Insensible *Corpuscles*, of different Magnitude and Figure If it fall out that many of these *Corpuscles*

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are united, they compose little Masses which we call *Molecules*. And if they continue separated from one another, by reason of great Agitation, they compose a Matter which we shall call the *Æthereal Matter*.

Whereas the *Molecules* are formed by the assemblage of parts of the *Æthereal Matter*; there is amongst them an almost infinite diversity, as well in respect of their Magnitude as their Structure and Figure. This will be evident enough to those who shall consider, that the parts of the *Æthereal Matter* are very different from one another. It is for this that the *Molecules*, which are made up of them, have great diversity amongst them. And since we have no reason to deny, but that they are of as many sorts as can be, we may well think that they differ amongst themselves an infinite number of wayes, as well in respect of their Magnitude, as of their Structure and their Figure.

To examine well the differences of their Structure and Figure, all the *Molecules*, may

may be conveniently reduced to five kinds. The first shall be of those which have *sharp Angles* on their Surface with much Solidity. We shall call these kinds of *Molecules*, *Acides*. The second shall be of those which have many Pores, great and open. These we shall name *Alcalis*. The third shall be of those which are branched, we shall call them *Sulphurs*. The fourth shall be of those which are long, and their Extremities like those of an Oval. We shall name them *Phlegme*. And in fine, the fifth shall be of those, which have not sharp Angles on their Surface, which are not very Porous, which are not branched, and which are not Cylindrical with Oval ends; but which are either round, or Oval, or rough, *&c.* and we call them *Earth*.

The *Æthereal Matter* flowes without ceasing through the Pores of the *Molecules*, it fills also all the spaces where there are no *Molecules*. And the *Molecules* compose all the Bodies which we call *Terrestrial*

A living Body is one of these Ter-

restrial Bodies which are composed of *Molecules*. Therefore *Acids*, *Alcalis*, *Sulphurs*, *Phlegme* or *Earth* must needs be in it. Being therefore that we have proposed to give a clear *Idea* of its Elements in this Discourse, we shall examine the nature of *Acids*, *Alcalis*, *Sulphurs*, *Phlegme* and of *Earth*.

Sect. II.

Of Acids.

TO understand well the Nature of *Acids*, we must examine their Figure, their Stature, and their Magnitude. As to their Figure, when I examine the matter nearly, I remark that there is amongst them almost an infinite difference. There are Conical, Triangular, Regular and Irregular of all sorts: There are of them whose Angles are very sharp, and others of them whose Angles are less sharp. There are who have many Angles, and others who have fewer. And since there may be amongst all this an Infinity of different

ferent Modifications, we make no ſcruple to ſay, that there is almoſt an infinite difference amongſt *Acids*, by reaſon of their Figure; Which makes me think, that it would be a fruitleſs labour to endeavour to know all the differences which are amongſt the *Acids*, by reaſon of their Figure The multitude of them being Infinite, we cannot hope to know them all. We ſhall therefore content our ſelves to know in general, that all the *Acids* have ſharp Angles on their Surface, without enquiring whether the Spirit of Sulphur, for example, has its parts Conical, Pyramidal, of many ſides, or otherwiſe.

As to the Structure of *Acids*; foraſmuch as it conſiſts in the ranging of the Particles of the *Ætherial Matter*, we need not doubt but that the diverſity which is amongſt them in this reſpect, is almoſt Infinite. In effect, the ranging of theſe Particles depends upon their Magnitude, as well as on their Figure and their Motion.

Now there is an Infinite difference in the Magnitude and Figure of the parts of the

Ætherial Matter, and they move an infinite number of wayes. There must therefore be an Infinite difference in the Structure of *Acids*.

Nevertheless, forasmuch as hardness depends on the Structure, because the more hard a Body is, it has the fewer Pores, or its Pores are the smaller, we may suppose that we know in general the Structure of *Acids*; in that they being the hardest of all the *Molecules*, they must have the fewest Pores, or at least such as are the smallest. It shall satisfy us to know this, without troubling our selves to no purpose, to discover all the Modifications which may be in the Pores of *Acids*.

As to the Magnitude of their parts, the difference is also infinite; so that to consider them in this respect, it is impossible to determine all the differences. If we consider in the mean time, that we find *Acids* whose parts are so subtil and so delicate that they are exhaled by a small Fire; as for example, the parts of the Spirit of *Venus*, whilst we find others so gross and Massy,

that

that they do not exhale but by the force of a vehement heat, such as the Oyl of *Vitriol*, the Spirit of *Allum*, &c. We may well reduce, by this means, the *Acids* under two kinds, by dividing them into *Fixt* and *Volatile*. The *Fixt*, are those which do not exhale, but by the force of a vehement Fire, and the *Volatiles* on the contrary shall be those which exhale by a moderate heat.

Sect. III.

Of Alcalis.

Since *Alcalis* are nothing but the most porous *Moletules*, to know them well, we need only examine their Figure, their Pores and their Magnitude.

We may say here of *Alcalis*, what we have said of *Acids* in speaking of their Figure, *viz.* That they are so many, that it is impossible to know them all The reason is, that their composition depends upon the motion of the Particles of the *Æthe-rial Matter*.

For since these Particles move every

way, they may in uniting themselves compose *Molecules* of all sorts of Figure, as well Regular as Irregular. So that the understanding, finding its self unable to examine them all, and wanting moreover means to accomplish it, must content its self to know that there are *Alcalis* of all sorts of Figure, without being anxious for the Figure of each *Alcali*.

It is good notwithstanding to remark here that some *Alcalis* have the Figure of *Acids*, that is, that many *Alcalis* have sharp Angles on their Surface. But because they have not Solidity, they do not produce the same effect. In speaking of the hardness of *Acids*, we have insinuated that it depends upon the small number or smalness of their Pores. Seing then the *Alcalis* are incomparably more Porous then the *Acids*, they must of necessity have very little hardness in comparison of the other, so that if some *Molecules* partake of an *Acid* because of their sharp Angles, and of an *Alcali*, because of the great number and wideness of their Pores, they cannot produce

duce the ſame effect which *Acids* produce, becauſe they have no ſolidity, and in certain rencounters they have not the effect of *Alcalis*, becauſe of the ſharp Angles of their Surface. We ſhall call theſe ſorts of *Molecules*, *Alcaline Acide* Partieles.

The Pores of *Alcalis* are alſo different from one another an infinite number of wayes, which is the cauſe we cannot determine them; from hence it comes, that not being able to know in particular the Structure of the Pores of *Alcalis*, we ſhall content our ſelves to ſay, that they have the wideneſs and Figure that is needful to produce ſuch an effect, when we are to ſpeak of a Phænomenon that depends upon them, which will ſerve on the like occaſions

As to the Magnitude of the *Alcaline parts*, tho' the diverſities that are amongſt them be infinite, yet we ſhall divide them into Fixt and Volatile as we have done the *Acids*. With this exception, that the *Fixt* Acids do exhale by the action of a great Fire, whereas the *Fixt Alcalis* do not exhale at all.

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We distinguish therefore *Alcalis* into *Fixt* and *Volatile*; the *Fixt* are those which subsist in the Fire, and change rather into Glass, than exhale. And the *Volatile* are those which exhale by a moderate Fire; as for ex the Spir of Sal, Arm. the Volatile Alcals of Harts-horn.

Sect. IV.

Of the mixture of Acids *with* Alcalis.

After having treated of the *Acid* and *Alcalis*, we must mingle them together, to see what will follow; and that we may follow a method that needs not be quarrelled, we shall say nothing in this Chapter, which does not follow from what has been said in the foregoing.

If we consider that a pure *Alcali* is composed of nothing but the most *porous Molecules*, it must needs be granted that a great deal of the *Ætherial matter* passes through the pores of its parts.

From hence it follows, that to the end a Body may subsist for a long time in the tor-

torrent of the *Ætherial matter*, the pores which are on its Surface muſt be no greater than thoſe which are in the middle. The reaſon is, that if the pores of the Surface were not a little near equal, the parts of the *Ætherial matter*, which ſhould enter on one ſide, could not get out on the other with the ſame freedom as they entered. They would therefore force by their great agitation all that ſhould oppoſe their paſſage, and conſequently break the union of the parts; the aſſemblage of which did make the pores too ſmall to permit them to paſs through them Here recourſe cannot be had to the groſſer parts of the *Ætherial matter*, which remaining on the ſurface of the Body might keep its parts united, by reſiſting them uniformly with as much force as the *Ætherial matter* that paſſes within: Becauſe all the parts of the *Ætherial matter* which are leſs groſs than what runs through the parts of the Body, do not enter, and conſequently reſt on the Surface. But in as much as they have leſs force than what is within, they are obliged

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to give way, and let them at this place make all kind of havock, by disordering all the parts of that Body, and breaking wholly the union of it. So that in that place where the Pores are narrower than in the rest, there will never fail to follow a dissolution of the parts

This dissolution or disordering of the parts falls out ordinarily by the mixture of some Heterogeneous body; whose parts enter into the pores of its Surface stop them, and consequently render them smaller. So that the *Ætherial matter* not being able to get out at this place, as freely as it entered, forces the Obstacle, disorders the parts of this Body, and makes its passage, till it can continue its way through all with an equal facility.

When this motion which disorders the parts of a Body is sensible, it is called *Fermentation*, and the Body by whose mixture it falls out, is called the *Ferment*. They distinguish five kinds of *Fermentation*. The first is called *Bubbling*. It is when the mixture of Bodies excites sometimes a visible motion

motion of the parts, accompanied with ſmall Bubbles, and ſometimes ſmall Bubbles of Air only. Theſe Bubbles are produc'd by the detachment of ſome moſt dedicate parts, which mingle with ſome parts of the Air, which is always to be met with amongſt the parts of Liquors. For in ſeparating, they ſcatter the other parts thro' which they paſs, and make to be gathered together in theſe places, enough of Air to make up a little Bubble, which by its Lightneſs aſcends to the Surface of the Liquor.

The ſecond is *Elevation*, which is when by the mixture of certain Bodies, the Bodies are blown up and ſwelled, or to ſpeak better rarified. Which is done when the diſſolution is not indeed ſenſible, but when the parts of the Diſſolvant are ſo figured that they cannot aſſociate with others without taking up together more place, than when they were ſeparated.

The third is *Sparkling*, which is when the mingled Bodies diſſolve with a kind of hiſſing, accompanied with ſmall and interrupted ſounds. Then the parts which are diſ-

ordered

ordered encline and bow by the action of the Ferment. These parts thus bended, make a spring and excite thereby in the Air all those little motions, which may produce in us the Sensation of Sound.

The fourth is *Effervescence*, which is done, to speak properly, when by the mixture of bodies there is made a dissolution of parts, accompanied with some degree of heat. For if the dissolution be not made but by a great effort of the *Ætherial matter*, the motion which the parts acquire becomes great enough to excite in us the sensation of heat.

In fine, the fifth is *Exhalation*, which is done when the disordering of the parts is accompanied with Fumes. Which falls out when by the disorder, some subtile parts acquire motion enough to ascend visibly in the Air, whiles the more gross parts remain in the Masse.

After all these Reflections, it may easily appear that a *Fermentation* must follow upon the mixture of *Acids* with *Alcalis*. For *Acids* being pointed and *Alcalis* porous, if they

they be mingled together, the points of the *Acide* will enter into the Pores of the *Alcalis*, and render them consequently smaller. So that the *Ætherial matter* cannot get out at that place with the same facility that it enters. It will therefore disorder the parts amongst which the points of the *Acids* have been received, and this disorder or fermentation will last till the *Ætherial matter* can pass through all with an equal facility.

Moreover according as the Pores of the *Alcalis* are great or small, and the points of the *Acids* in comparison of the *Alcalis* great or small, the Fermentation will be a *Bubbling*, or an *Elevation*, or a *Hissing*, an *Effervescence* or *Exhalation*. Sometimes two of these kinds of *Fermentations* will be observed at once, as the *Hissing* and *Bubbling*, the *Exhalation* and *Effervescence*, &c. Sometimes three of them, whiles four, and sometimes all of them. For according as the pores of the *Alcalis* are a little more or less stopt by the Angles of the *Acids*, the *Ætherial matter* will move with more or less force the parts of the Body which is Fermented.

mented. And it is from this greater or lesser Agitation and Commotion that all the kinds of Fermentation derive their Origine.

From all this may be easily gathered that the *Fermentation* must last, when it is once begun, till the *Ætherial matter* can pass without hinderance through the Pores of the *Alcalis*, which are mingled with the *Acids*. Which is done when the parts have been so disordered, as that all the pores which were before formed, are destroyed, and others formed of a near equal wideness. For when things are brought to this State, the subtile matter meets no stop in its passage. Therefore it passes straight forward without moving any part of the Body through whose Pores it passes.

When the parts of this *Alcalis* have been disordered thus by *Acids*, they recover ther first calm, and are so united with them, that there results from both a body of a third species, which is neither Acid nor Alcali, but a composure of both, which we shall call a *Salt*. So that *Salts* are nothing but porous Bodies, whose Surface is made

all

all rough by the points of the *Acids* which are faſtned to it.

There is no property remarked in *Salt*, which is not a Conſequent of what we have ſaid, as we could demonſtrate, if we did treat here of Salt as it ought to be treated in Phyſick. But ſince we ſpeak of it only as a reſult of the mixture of *Alcalies* with *Acids*, we ſhall ſay only, that as there is an almoſt infinite diverſity of *Alcalies* and *Acids*, ſo there are ſo many differences to be found amongſt *Salts* that it is impoſſible to determine them all. Nevertheleſs it is fit to remark that the moſt part of theſe differences depends upon *Acids*. For ſince *Salts* do not act on Bodies, but by the points of *Acids*, which are raiſed on the Surface of the *Alcalies*; all the difference which is to be met with in theſe properties, depends upon the Acid points, which act ſometimes one way, ſometimes another, as they are more or leſs ſharp, in a greater or leſſer number.

There are notwithſtanding *Salts* which differ amongſt themſelves by their *Alcalies*,

as may easily appear by what we have above said. For if a certain *Acid* be mingled with a *Volatile Alcalie*, it is not to be doubted, but there results from this mixture a Salt, which will be different from the Salt resulting from the mixture of the same Acid with a *Fixt Alcalie*. For that the *Volatile Alcalies* have their parts incomparably more delicate than the *Fixt Alcalies*. From whence it follows, that the parts of the Salts must be also incomparably smaller, which suffices to make a difference between the Salts.

We may found a division of Salts into *fixt* and *Volatile*, from what we have said: The *fixt Salts*, are those who have their parts so gross, that they do not exhale with any heat, as *Sea Salt*, *Vitriol*, *Saltpetre*, &c. And *Volatile Salts* are those which do exhale by a moderate heat, as the *Flowers of Sal Armoniack*.

SECT.

Sect. V.

Of Sulphurs.

WE have ſaid nothing hitherto of the Figure, Structure and Magnitude of *Acids* and *Alcalies*, which may not alſo be underſtood of the Figure, Structure and Magnitude of *Sulphurs*. In effect, if it be conſidered attentively, it will eaſily appear that there is an infinite diverſity of *Sulphurs*, by reaſon of their Figure. For if one *Sulphur* have parts more branched than another. if it have parts whoſe branches are ſhorter or longer, or otherwiſe ranged than another, it will be infallibly different, and conſequently capable of producing different effects. And foraſmuch as there may be amongſt all this an Infinity of Modifications, it ſeems to me evident enough, that there may be alſo an Infinity of differences amonſt *Sulphurs* in reſpect of their Figure.

There is no leſs diverſity amongſt them in reſpect of their Structure. For ſince *Sulphurs* are made by the aſſemblage of parts

of the *Ætherial matter*, since these parts may be assembled an infinite number of wayes, it is clear there may be of *Sulphurs* an infinite variety as to their Structure.

If moreover we consider their Magnitude, we perceive there is no less difference amongst them as to this. For since matter is divisible *in infinitum*, there may be an Infinite difference amongst the parts, some of which are grosser than others, because there is no Magnitude which may not be augmented, without acquiring in the mean time the Magnitude of another which is a little grosser than it.

We cannot therefore, what tour soever we take, place *Sulphurs* under certain kinds, by considering simply their Figure, Structure or Grandeur. Nevertheless, since we have reduc'd *Acids* and *Alcalies* under two kinds, by dividing them into *Fixt* and *Volatile*; notwithstanding the infinite difference there is amongst their parts, we may do here the same thing as to the *Sulphurs*. And since there are *Sulphurs* which do not exhale but very difficultly, and others which

which exhale by moderate heat; we may be allowed to call the former *Fixt Sulphurs*, and the later *Volatile Sulphurs*.

The *Fixt Sulphurs* do not exhale but very hardly, for that their parts are groſs, and garniſh'd with groſs branches. For then as ſoon as they are agitated, they communicate almoſt all their motion, to the parts of the Bodies which environ them. So that they cannot acquire as much as were needful to exhale them without an extreme heat. Whereas the *Volatile Sulphurs* having their parts very delicate, and their Branches moſt ſubtile and cloſe, they move eaſily. Therefore a moderate heat is capable to give them agitation enough to raiſe them into an Exhalation.

Sect. VI.

Of the mixture of Sulphurs *with* Acids *and* Alcalis.

After having examined the nature of *Sulphurs*, it will not be amiſs to mingle them with the Elements, whoſe nature we know, to ſee what will follow.

Since *Acids* are *Molecules*, which have many *sharp Angles* on their surface, and *Sulphurs* are *Molecules* branched, if we mingle an *Acid* with a *Sulphur*, the *Acid* must coagulate the *Sulphur*: In effect, when we mingle an *Acid* with a *Sulphur*, the *Acid* engages its points amongst the Branches of the *Sulphur*; by this means it holds the parts and gathers them so together, that by little and little they lose their motion and co-agulate. So it may well be said in general, that *Acids co-agulate Sulphurs*.

If the nature of *Alcalies* be well considered, it will easily appear that they must act on *Sulphurs* in a way quite opposite to that of the *Acids*. For if *Acids* co-agulate *Sulphurs* in embarrassing their points in their Branches, the *Alcalies* which are without points must dissolve them. In effect, when the *Alcalies* mingle with the *Sulphurs*, they separate the parts, by placing themselves amongst them. They free them of one another, so that having no more union, the whole becomes more Liquid. And so it may well be said in general, that *Alcalies dissolve Sulphurs*. SECT.

Sect. VII.

Of Phlegme.

BEſides *Acids*, *Alcalies* and *Sulphurs*, there are alſo *oblong Molecules and Poliſht*, whoſe two ends are almoſt blunted, like the extremities of an Egg. Theſe parts compoſe the *Phlegme* or Water, when they are aſſembled in a conſiderable quantity.

The difference which may be amongſt the Phlegme, as to their Figure, is ſo ſmall, that it does not merit we ſhould ſtop at it. For as they are all oblong and poliſht, the more or leſs that may be met with in this Figure, is not capable of producing effects, amongſt which there can be great difference

The ſame thing may be ſaid as to their Magnitude, which is never ſo different, as upon that head to diſtinguiſh them into *Fixt and Volatile*. On the contrary, for that their parts are poliſht and oblong, they do never embarraſſe ſo ſtrongly with other Principles, but that a little motion will ex-

tricate them, and consequently a very small heat raise them into a Vapour So that to consider them, after this manner all *Phlegmes* must be *Volatile*.

Sect. VIII.

Of the mixture of Phlegme *with* Acids, Alcalies, *and* Sulphurs.

Since *Acids* are the most solid and most angulous *Molecules*, all that can befall them by the mixture of *Phelgme* is dissolution. In effect, when we consider that parts so Figured as to have many angles on their surface, when they are gathered together, do not touch frequently but by the points of their angles; it will easily appear, that having so slender an union, a little force will shake them. And forasmuch as the dissolution of a Body is nothing but the disorder of its parts, the *Phlegme* having enough of force to disorder the parts, the *Acids* must be dissolved.

Besides the dissolution of *Acids*, which is made by the mixture of *Phlegme*, their force

force is extremely weakned, which is not by the diviſion of their angles; but rather for that the *Phlegme*, which keep the parts of the *Acids* diſtant one from another, have not the ſame force to act upon certain Bodies, that we obſerve of *Acids*.

All that we have ſaid of the mixture of *Phlegme* with *Acids*, muſt alſo be underſtood of the mixture of *Phlegme* with *Alcalies*. For the ſame reaſon which has made us conclude that *Phlegms* diſſolve *Acids*, muſt make us think that they diſſolve *Alcalies*. Yet it is true that *Phlegme* muſt diſſolve *Alcalies* with ſome leſs trouble than they do Acids, for that the *Alcalies* being only porous parts, they touch them in more places than the *Acids* So that they require leſs force to diſorder them. Their diſſolution muſt alſo diminiſh their activity, for the ſame reaſon that the diſſolution of *Acids* by a mixture of *Phlegm*, does weaken their force For if the parts of water cannot produce the ſame effect with the parts of *Acids*, neither can the ſame parts of water do the office of the *Alcalies*. The ſame

thing

thing may be freely said of *Salts*, for that the *Saline Particles* not being joyned together, but by the points of their *Acids*, they may be disordered by the least force, so that the *Phlegme* striking against them, shake and separate them one from another with great ease. The *Phlegme* must also weaken the Salts after the same manner that they diminish the force of the *Acids and the Alcalies*.

But the Phlegmes must produce on the *Salphurs* an effect quite contrary to what they produce on the *Acids*, the *Alcalies* and the *Salts*. For that the *Sulphurs* having their parts branched, their brances do so engage amongst one another, that they do not leave between them *Interstices* or *Spaces* large enough to give way to the parts of the *Phlegme*. So that the *Phlegms* not being able to thrust themselves in amongst the parts of the *Sulphurs*, and moreover not being able to separate the parts which close one upon another, without detaching themselves when they are encountered, instead of dissolving them, they must set them closer together. For the parts of the *Phlegme* stricking

ſtricking on all ſides the parts of the *Sulphurs*, without ſeparating them from one another; and not being able to enter into the pores which they leave between them, they preſs them, the one againſt the other, and in ſome manner encreaſe their union. Hence it comes that Oyles cannot mingle with water.

Sect. IX.

Of Earth.

WE have not only remarked *Acids*, *Alcalies*, *Sulphur*, *Phlegme* amongſt the *Molecules*, but we have found alſo a fifth kind of Particles, which is different from the reſt. Theſe are they which have not ſharp angles on their ſurface, but are rough and unequal, which have fewer pores than the *Alcalies*, and are leſs ſolid than the *Acids*, which have not the branches of the *Sulphurs*, nor the figure of the *Phlegme*, in a word, which have nothing for their whole ſhare, but a ſurface very unequal, with a conſiderable enough ſolidity, and we have called them *Earth*. When

When we consider their Figure, Structure, and Magnitude, we can say nothing of them but what we have said already of the Figure, Structure and Magnitude of *Acids*, *Alcalies*, and *Sulphurs*. Which has obliged us to distinguish them into *Fixt and Volatile*. So we find that there may be parts of *Earth* gross enough to subsist in the Fire, which we shall call *Fixt Earth*; and there may be also, which cannot subsist in the Fire, but do exhale by a moderate heat, and we shall name them *Volatile Earth*.

Sect. X.

Of the mixture of the Earth with the other Elements.

IF we reflect on the nature of *Acids*, *Alcalies*, *Sulphurs*, *Phlegme* and *Earth*, we shall see that there cannot result a great matter from the mixture of *Earth* with the rest. For it cannot dissolve them, nor Coagulate them, nor excite in them any Fermentation. So that all that it operates, is to trouble the purity of other Elements with which it is, and consequently to diminish their

their force. Nevertheleſs, as the moſt part of Bodies are compoſed of many of our Elements, and ſometimes of them all, the Earth is not entirely uſeleſs. Since it finds a place amongſt the other Elements, and fills the ſpaces which they leave between them, and by this means renders the whole body more maſſy and more firm.

Sect. XI.

Of the manner of knowing the Elements *which enter into the Compoſition of particular Bodies.*

IT is nothing to know that there are *Acids*, *Alcalies*, *Sulphurs*, &c. We muſt know which of them are in particular Bodies To come to the knowledge of this, we make uſe of *Chymie*, becauſe it ſeparates the Elements one from another, and collects them as much as is poſſible in their Elementary purity.

It accompliſheth this by the means of Fire, which is an univerſal Diſſolvant The Fire by its great ſubtilty enters into the pores

of Bodies, and by its great agitation moves their parts and breaks their union. So that in continuing to agitate and disunite them, those which are most *Volatile* separate from the rest, and the more Fixt abide in the Fire. After which we separate them from one another, by the mixture of some other Body; and in fine, collect them in their Elementary purity.

For example, if I would know of what principles a *Plant* is composed, I take a great enough quantity of it, beat it in a Mortar, and without any more adoe, put it in a Cucurbite. I place my Cucurbite on a Furnace, and afterwards put on the Cucurbite an Alembick, and to the Pipe of this Alembick, I put a Recipient I give it Fire as it ought to have, which acting upon my Cucurbite, makes by Vapour to ascend into the Alembick, all that is *Volatile* in the Plant. Ordinarily if it be an Odorous Plant, we find some drops of *Sulphur* which swim upon the Water. We call these Sulphurs *Essences*. Besides these Sulphurs, which are known for such, not only for that they easily kindle when

when they are caſt into the Fire, but for that *Acids* co-agulate them, and *Alcalies* diſſolve them. There are ſome *Acids*, or ſome *Volatile Alcalies*, which are diſſolved in the Water. We know them by means of the Fermentation which they excite, either with *Acids*, or with *Alcalies*. For if they ferment with *Alcalies*, we do not fail to conclude, that they are *Acids*; and if they ferment with *Acids*, we conclude they are *Alcalies*. Thus we diſcover that in the Plant there are *Phlegme*, *Volatile Sulphurs*, *Volatile Acids* or *Alcalies*.

After this, that we may know what there is of Fixt; I take what remains in the bottom of my Cucurbite, and expoſe it to the Fire; if it take flame, I conclude that in the Plant there are fixt *Sulphurs*, which could not aſcend by Diſtillation. Afterwards I reduce the whole to aſhes, and to know of what theſe aſhes are compoſed, I make a Lee of them. The Water diſſolves all that there is of *Acid*, *Alcali* and of *Earth*. I paſs my diſſolution through Gray-paper, to the end I may have nothing but the *Salts*,

Acids,

Acids, or *Alcalies* dissolved in Water. And the *Earth* being too grosse to pass through the pores of the Paper, remains within, and then I see how much *Earth* enters into the Composition of the Plant. I take after this my dissolution which I set upon the Fire. The Fire by its activity makes all the water to exhale, and what there is of fixt, remains in the bottom of the Vessel. I examine it, and see if it be an *Alcali*, by mingling it with an *Acid*; or if it be an *Acid*, by mingling it with an *Alcali*, by the Fermentation which it will excite with the one or with the other. But if it do not ferment at all, neither with *Acids* nor with *Alcalies*, I conclude that it is fixt Salt.

Thus I know all the Elements which enter into the Composition of a *Plant*, and how we may operate almost upon all Terrestrial Bodies, to extract their Elements. Chymie is the only Science whereby we may know aright of what Bodies are composed.

The most part do not grant this, because they imagine that the Fire acting upon Bodies

dies changes all their parts; so that the divers Elements which we extract from Bodies by the means of Chymie, were not there in their opinion, such as they are when we extract them. But I have great reasons to be of another Sentiment. Which are 1. for that the Fire does not change *Acids* into *Alcalies*, nor *Alcalies* into *Sulphurs*. For though the Fire by its great agitation may produce some change into the parts of a Body; yet it is inconceivable that it can change the Principles by spoiling them of their Nature to cloath them with the nature of another. Thus therefore though it were even true, that the Fire should produce some change in the parts of Bodies upon which we operate to extract their Elements; yet it is certain that what is extracted of *Alcali*, was there under the form of *Alcali*; what is extracted of *Acid*, was there under the form of *Acid*, &c.

But that which obliges me chiefly to think that the Fire makes no change in the Elements of Bodies which are extracted by Chymie, is, that if we take the Spirit of *Salt*

and mingle it with the Fixt *Alcali* of *Tartar*, we make a true Salt of it, and if we take the Spirit of *Nitre*, and mix it with the Salt of *Tartar*, we make a true *Nitre* of it. Nevertheless all they who can operate in Chymie, know well enough that the Fire must be blown with an extreme violence to distil the Spirit of *Salt* and the Spirit of *Nitre*. So if the Fire should produce any change in the Elements that are drawn from Bodies by its means, it would be chiefly in the Distillation of the Spirit of *Salt* and Spirit of *Nitre*, where it must act with all its force.

Nevertheless, Experience makes appear that there is no change produced, and that the Spirit of *Salt* and Spirit of *Nitre* were such in the *Salt* and in the *Nitre*, as they are when the Fire has separated them from the other Element, with which they must be mingled to constitute the *Salt* and the *Nitre*; since we make a true *Salt* and a true *Nitre*, by mingling them with that other Element, which is the *Salt* of *Tartar*.

We are convinced by true Philosophy, that

that Odours are nothing but the moſt ſubtil parts which get away from Odorous Bodies, and ſpread in the Air by way of Exhalation. We are not ignorant likewiſe that it is from the different Magnitude and Figure of the parts, that all the diverſity of Odours does proceed. So that there muſt be a certain Magnitude and Figure in theſe parts to excite a particular Odour. And if it fall out that this Magnitude or Figure comes to be changed by whatſoever cauſe, the Odour which theſe parts ſhould excite after this in us would not be the ſame. But we extract by Chymie the Odorous parts of Odoriferous Bodies, without making any change in them: Since they excite in us the ſame Odours which the Bodies do from whence they were extracted. Witneſs the Eſſence of *Roſemary*, *Gilly-flowers*, *Cinamon*, &c. from whence we may with reaſon conclude, that the Fire does not produce any changes in the Elements which are extracted from Bodies by the means of Chymie.

And ſince many different Liquors are to

be found in Animals, which are composed of divers Elements, we shall make use of the Chymie to separate them from one another, and to examine them apart, that we may know the nature of each in particular. After this we shall easily see what may be their uses in the animal Oeconomy, and what effects do depend upon them.

The second Discourse.
Of the Blood.

WHen I strike a Lance into any outward part of a living Animal, I remark that there comes from the wound I have made a red Liquor, which I call Blood.

I imagine that it is very important to know the nature of it aright, for I find it so spread through all the Body, that there is no part which is not watered with it. Which obliges me to gather a little of it in a Vessel and to know if it be not some of our Elements, or if it be not a composition of them. I mingle it first with *Acids*; and I find that they

they co-agulate it; in such a manner notwithstanding that they co-agulate but a part of it, and that remains another very Liquid and Transparent, which we call *Serosity*. In the second place I take the Serosity and mingle it with *Acids*, and I find that there is made by this mixture a little Fermentation.

From hence I conclude, that there are in the Blood much *Sulphur*, and some *Alcali*; that the *Sulphurs* are that which has been co-agulated by the *Acids*; and that the *Alcalies* are that which ferments with the *Acids*, which we mingled with the *Serosity*.

I do not satisfy my self with this, I take *Alcalies* and mingle them with the Blood, to confirm what I conjecture by some new Experiment. And it falls out that the Blood is extremely dissolved by this mixture. And as I know that the effect of *Alcalies* on *Sulphurs* is Dissolution, I am confirmed the more in the opinion I have, that in the Blood there is a great deal of *Sulphur*.

The small Fermentation which the

Acids have excited in the Serosity, makes me think that there is in the Serosity something more than *Alcalies*; and by consequent that there is through all the Blood some other Principle than *Sulphurs* and *Alcalies*. To know therefore the truth of the matter, I take a considerable quantity of Blood, I put it in a Cucurbite, I place my Cucurbite in a Furnace to distil some part of it by Sand. I adapt a Head to my Cucurbite, and to the Pipe of the Head I apply a Recipient. I take care to lute the Junctures well, and give it a little Fire at first, and augmenting it afterwards by degrees, I dry gently all the Blood which I had put in my Cucurbite.

Whilst the Blood is thus drying, there arise some Vapours in the Alembic, which gathering in its concave Surface, run in drops of Water through the Pipe into the Recipient. I take this water and try it, by putting it on my Tongue. A little savour that it excites there, makes me judge that it is not pure *Phlegme*; I mingle *Alcalies* with it, and I remark no Fermentation.

Which

Which makes me think, that what is in this Water is not *Acid*. I mingle afterwards *Acids* with it, and I perceive by the light Fermentation that ariſes from this mixture, that there are *Alcaline* parts extremely *Volatile* mingled with much *Phlegme*.

I take out (after this) that which is dryed in my Cucurbite, and I put it in a Retort, which I place on a Furnace proper for this. I give it Fire by degrees, and there comes out of my Retort a ſtinking Oyl, which is the *Sulphureous* part of the Blood. With the ſtinking Oyl there comes out a great quantity of whitiſh Particles, which ſtick to the neck of the Cornute, and to the concave Surface of the Recipient, as if it were a moſt delicate hoar Froſt.

I examine the ſtinking Oyl, by the mixture of *Acids* and *Alcalies*. The *Acids* Co-agulate it, the *Alcalies* Liquify it, which will not let me doubt that it is a true *Sulphur*. I do the ſame with the whitiſh Particles, which I rub off from the neck of the Cornute, and the ſides of the Recipient

pient, and I learn by the great Fermentation they make with *Acids*, that it is nothing but an *Alcalie*, which rising by a moderate heat, is very *Volatile*. I have therefore three *Volatile* Principles which compose the Blood, *viz.* A most considerable quantity of *Phlegme*, much of a *Volatile Sulphur*, and yet more of a *Volatile Alcalie*. That I may know now what remains in the the bottom of the Cornute, I put it in a Crucible, and Calcine it by a wheel Fire. There is some small matter that yet Exhales. And in fine, after the whole have been well Calcin'd, I make a *Lixivium* of it, which I filter. I make a part of the Water to evaporate, which makes up the *Lixivium*. I put the rest in a cool place, and there Chrystallizes somewhat about my Vessel in form of a *Salt*.

I take this *Salt* and mingle it with *Alcalies* and *Acids*. The *Alcalies* do not move it, but the *Acids* excite a Fermentation, yet less than what they do with the *Volatile Alcali* of Blood. Which makes me think that it is a *Fixt Alcalie* with which

which there may be some *Acid* mingled.

I perceive after this, that there remains some Terrestreity in the Paper through which I filtered the *Lixivium*, from whence I had extracted the *Fixt Alcalie*. So that after having examin'd all, I find that the Blood is a Composure of *Volatile Alcalie*, *Fixt Alcalie*, *Volatile Sulphur*, *Phlegme*, *Earth*, and it may be some little *Acid* mingled with the *Fixt Alcalie*. So that it abounds more in *Sulphur*, in *Volatile Alcalie*, and in *Phlegme*, than in any other Principle. For there is little of *Fixt Salt*, and almost no Terrestreity.

We may easily understand by this, the reason why through a Microscop there are to be seen in the Blood many small red Globules which swim in a Chrystalline Liquor, while the Blood is put into small Pipes of Glass. The *Sulphurs* which are more disposed to keep themselves united to one another, because their branches are embarrassed, do swim in a Liquor compos'd of *Phlegmes* and *Alcalies*. The *Phlegmes* by their motion press those branched Particles

ticles one against another, and oblige them to form small *Sulphureous* Globules, after the same manner that the Air makes the drops of water Sphærical. And the *Alcalies* make the smalness of these Globules, and oblige the Sulphureous parts of the Blood to assemble in small Bodies, by keeping them separated one from another.

We see also the reason wherefore curdled Blood, after having been washed in cold water, seems all Fibrous: For cold water dissolves the *Alcalies* and carries them away. Afterwards it assembles the *Sulphurs*, which fall down to the bottom of the Vessel like a Glairous matter, and composed of small Fibres like Glue.

It is also for the same reason, that when we receive the Blood amongst hot water, as soon as is comes out of the Vein, there gathers about small Rods which you put into it a Mucilaginous and Glairous substance. For the *Alcalies* spread through all the water with the *Sulphurs*, and strike together against the Surface of the small Rods. The *Alcalies* never fix to them, be-

because they have not proper Particles for this; but the *Sulphurs* insinuate into the Pores of the Wood, which are opened by the heat of Water, the extremities of their Branches. So that finding themselves engaged, they continue fixed there, and the other *Sulphureous* parts of the Blood which swim in the Water joyn to the first, so that *in fine*, when the Water is become Cold, we find the *Sulphurs* of the Blood upon the Surface of the Rods, like to a Glaire, or a Mucilage.

The third Discourse.

Of the Glandules.

WHen we follow the *Arteries* and the Veins, wee find that a great number of their Branches end at certain round Bodies involved in a most delicate Coat; and from which Bodies there comes a Canal, and from thence flows a Liquor quite different from the Blood.

The Anatomists call these round Bodies, *Glan-*

Glandules. There are three considerable things to be remarked in them. The first, that each *Glandule* receives a Branch of an *Artery*, which carries the Blood to it, and that there goes from it a Branch of a Vein which carries the Blood away. The second, that there goes a Canal from each *Glandule* from whence flows a Liquor different from the Blood. And the thrid, that the Composition of *Glandules* is of two sorts, some are nothing but a heap of small Vessels contorted, which reuniting, make the Canal through which there flows a particular Liquor. And others, are nothing but an assemblage of little Vesicles. In some places these Vesicles are angular, and there is a Communication between their Cavities. So that they end all into two or three, whose prolongation makes the Canal, from whence flows the Liquor which is different from the Blood. In some others there are separated Vesicles, which send each one in Particular a little Canal. Those, which are nothing but a heap of Contorted Vessels we shall call *Vascular Glandules*, and

and thoſe which are compoſed of nothing but a heap of Veſicles, we ſhall name *Veſicular Glandules*.

If we reaſon upon theſe three things, we will eaſily diſcover the nature of *Glandules*. The arteries bring the Blood, which after having watered the Veſſels or Veſicles of the *Glandules*, returns by the Veins which go from them, Now the *Glandules* are nothing but a Compoſure of ſmall Veſſels or Veſicles, full of a Liquor different from the Blood. But for that we have not hitherto diſcovered any Veſſel which brings any thing to the *Glandules*, but the Arteries which carries Blood thither, we may well think that this Liquor is a certain portion of Arterial Blood, which has been ſeparated from it by the Veſſels or Veſicles, and has been collected into their Cavity, from whence it comes that this Liquor flows alwayes from the *Glandule* by the little Canal which comes from it, and which we ſhall call the *Excretory Canal*.

The difference that is between this Liquor and the Blood, ought not to keep us from

from being of this sentiment. For since the Blood is composed of heterogeneous Principles, a certain portion of one, or many of these Principles, may be separated from the Blood into the Cavity of the Vessels or Vesicles of the *Glandules*. And for that the principles of the Blood are not to be met with there, whether in number or proportion sufficient to make Blood; the Liquor that results from this Assemblage, must be a Liquor quit different from Blood.

Thus the Liquor that flows from the *Glandules*, by their Excretory Vessels, must come from the Blood. But that which confirms us yet more in this Sentiment, is that we can extract nothing from this Liquor by Chymie, which we do not draw from Blood: which is an evident enough mark, that this Liquor is no other thing, but an Assemblage of certain principles which have been separated from the Blood, by means of the *Glandule*.

As to the Liquor which one *Glandule* separats from the Blood, we observe that it is alwayes the same. Nevertheless, we

must

muſt not for this imagine that all *Glandules* ſeparate the ſame Liquor. Experience makes appear to us moſt conſiderable differences between the Liquors which proceed from different *Glandules*. Which abundantly ſhews, that for the moſt part, diverſe *Glandules* ſeparate different principles from the maſſe of Blood.

But as this does not entirely ſatisfie the mind, it will not perhaps be impertinent to enquire into the manner, how the *Glandules* do ſeparate from the Blood, the Liquors which flow from them. That wee may ſucceed in this enquiry, I remark that the *Arteries* bring the Blood into the Body of the *Glandule*, that the Blood is a Compoſure of heterogeneous parts, that ſome of theſe heterogeneous parts go out of the Cavity of the *Arteries*, and gather into the Cavity of the Veſſels or Veſicles, which compoſe the *Glandule*. From whence I conclude, that there are paſſages from the Cavity of the *Arteries* into the Cavity of the Veſſels or Veſicles of the *Glandules*, and ſuch Paſſages as that no other principle of

the

the Blood can pass thither, but these which are absolutely necessary for making up the Liquor which flows from each *Glandule* in particular. We shall call these sorts of Holes, or Passages, *Pores*.

To the end that the thing be thus done, these Pores must be proportioned to the Magnitude and Figure of the parts which are separated from the Blood, that they may be gathered into the Vessels or Vesicles of the *Glandules*, whiles parts of another Magnitude and Figure cannot pass through them. For then the Blood coming to run in the *Arteries*, which are spread through the substance of the Vessels or Vesicles of the *Glandules*, those of its parts which can pass through the Pores, when they come thither are engaged in them. And for that the Blood continues to move in the *Arteries*, the parts which are engaged in the Pores through which they can pass, are thrust forward, and being followed by others which have the same fate, they are in fine press'd foreward into the Cavity of the Vessels or Vesicles of the

Glan-

Glandules There they mingle with many others which are come thither after the ſame manner, and compoſe with them the Liquor which flows from the *Glandule* through its Excretory Veſſel.

But for that the Liquor which runs from one *Glandule* is made up of Heterogeneous parts, it muſt needs be that the *Pores* of each *Artery* are not all equal. So that according as the Liquor of one *Glandule* is compoſed of *Sulphurs*, *Alcalies* or *Phlegms*, there muſt be proportionably in the *Arteries* of that *Glandule*, *Pores* fitted to let *Alcalies*, *Sulphurs* or *Phlegms* paſs through them.

We may even affirm, that not only the *Pores* of the *Arteries* of *Glandules* are not all equal amongſt themſelves; but alſo that thoſe of the *Arteries* of one *Glandule* are ſometimes entirely different from thoſe of the *Arteries* of another. The reaſon is, that there comes ſometimes from one *Glandule* a Liquor entirely different from that which flows from another.

After this, it is to be obſerved, that

there are *Glandules* to be met with alone, without being joyned to any other. These are called *Conglobated Glandules*, because they are considered as little *Globes*, which separate a Liquor from the Blood. But when there is an assemblage of them, and that they are all folded up within one Coat, and that all their Excretory Vessels are united in one, and so compose one Canal through which the Liquor runs, which they have all with one accord separated from the Blood, they are called *Conglomerated Glandules*

The greatest part of the *Conglomerated Glandules* are *Vascular*, and the most part of the *Conglobated* are *Vesicular*. As those may see who will give themselves the trouble to make the enquiry. And sometimes there are *Conglobated Glandules* which are *Vascular* in some Animals, and *Vesicular* in others.

The

The Fourth Diſcourſe.

Of the Nerves.

THe Surface of the *Brain* and of the *Cerebellum*, as well as the inner part of the Marrow of the Back-bone, are made up of nothing but a heap of ſmall round Bodies. It is obſerved that they receive *Arteries*, they ſend off Veins, and there goes from them a ſmall white *Fibre*. The *Arteries* do bring them Blood, after that it has watered them it returns by the Veins. But ſince it is not found in the Veins with the ſame qualities which it had in the *Arteries*, we may well conjecture that it has left ſomething in theſe round Bodies, which occaſions all this Change.

In effect, this Change does not befall the Blood, but either by the Addition of ſome new matter, or the loſs of ſome of its parts. It will eaſily appear that it is not from the addition of any new matter, if we conſider that theſe little round Bodies receive nothing but from the *Arteries*.

For if they made this alteration in the Blood by communicating unto it any new Liquor, they ſhould receive it elſewhere. The reaſon is, that the Blood paſſes continually through theſe round Bodies, and is alſo continually changed. So they muſt inceſſantly Communicate unto it this Liquor, which cannot be, if they do not receive it from ſome inexhauſtible ſource. Since therefore this ſource is not known, we may reaſonably think that this Change does not befall the Blood by the addition of any new matter.

It muſt needs then be occaſioned by the loſs of ſome of its parts. And becauſe this change is ſenſible, it cannot fall out but by the loſs of a conſiderable number of its parts; which ſince they cannot ſtay in theſe round Bodies, becauſe they are perpetually parting from the Blood, they muſt needs go through ſome paſſage to be carried elſewhere.

When we examine narrowly theſe round Bodies, we find nothing in each of them, but *Arteries*, *Veins*, and a ſmall white

Fibre.

Fibre. The parts which are ſeparated from the Blood, do not go by the *Artery*, ſince it is by the *Artery* that the Blood comes to the round Body; neither do they go by the *Vein*; for if this were, there would be no difference between the Blood of the *Artery* and that of the *Vein*. It remains therefore, that they paſs through the ſmall white *Fibre*. And thus we find that the Surface of the Brain, is nothing but a compoſure of ſmall *Glandules*, which do receive Blood from the *Arteries*, which ſend it off by the *Veins*, and which have their Excretory Veſſels from whence the the Liquor flows which they have ſeparated from the Blood.

There are two ſorts of Subſtance taken notice of in the Brain, the *Cerebellum* and the *Spinal Marrow*. The firſt is that Glandulous Subſtance, which making the Surface of the Brain and *Cerebellum*, is called their *Cortical Subſtance*. In the *Spinal Marrow*, it is found in the middle covered with the other Subſtance. And the other, which is a white Subſtance, more

firm than it, is nothing but the assemblage of the Excretory Vessels of the Glandulous Substance. They call it in the Brain and Cerebellum, the *Callous Body*, or the *Marrowie Substance*. And in the *Back*-bone it has no Name.

The Vessels which compose the Callous *Body* of the *Brain* and Cerebellum, are so interwoven, that they resemble a Net. It has not as yet been discovered, whether they are Inosculated, or if the Nets be made only by their passing one over another.

In fine, they gather into little *Bundles*, which are found shut up into Membranous sheaths. According as they advance into the *Body* of the Animal, they are divided into many small branches, and after this manner spread themselves through all. So that there are very few parts in the *Body* of an Animal, which does not receive its portion of them.

In the *Nerves* the Excretory Vessels of which they are composed have no Communication; even it is not remarked that

they

they are Interwoven. *But* they extend themſelves in length, coucht one above another, as if they were ſmall *Bundles* of little Cords.

I ſay, this falls out in the *Nerves*, that it may be obſerved that it is quite otherwiſe in certain Tumours faſtned to the *Nerves*, which are called *Olive* Bodies, or *Ganglions*. For theſe Olive Bodies are not formed but by the interweaving of the Nervous Veſſels. Even as the threed of which a ſling is made, ſeems to take up more room in the Body of the ſling where the Stone is plac'd, than in the ſtrings which are on either ſide.

Many *Nerves* meet together in diverſe places of the Body of an Animal, and are ſo interlaced one with another, that the Anatomiſts call theſe aſſemblages *Plexus*. They part afterwards from theſe *Plexus*, and ſpread round about.

It muſt carefully be obſerved, that when many *Nerves* meet in one, there is not an Anaſtomoſis of the Veſſels that Compoſe them, but only of their Coats. And when a *Nerve* is divided into many branches, its

particular Vessels are not branched into many, but the division is only in their cover, and the Vessels which are in one Bundle, are parted into many Bundles.

In fine, the use of the *Nerves* is to distribute the Liquor which runs into the *Fibres*, into all the parts where they terminate. As to this Liquor, it must needs be composed of the most subtile and most *Volatile* parts of the Blood. It is look'd upon as a very subtile wind which passes through the *Fibres* of the *Nerves*, and that not without reason. For since it escapes our eyes, and that the best Microscopes are not capable to make us see it; we may well think that it is the most subtile of all the Liquors which are separated from the Blood through the *Glandules* of the Body of an Animal. This Liquor is called the *Animal Spirits*, because of its great subtility, and because it is the Soul, which makes Animals to live.

Though nothing of this Liquor can be gathered to examine its nature, by mingling it with *Acids* and *Alcalies*, yet we are en-

enclined to think that the *Volatile* Alcalie prevails in it with an extremely *Volatile Sulphur*. The reaſon is, that all *Volatile Alcali's* taken inwardly, do encreaſe the Animal Spirits, the *Volatile Sulphurs* do almoſt the ſame thing, and there is nothing which does ſo much encreaſe their quantity, as *Sulphureous Volatile Alcalies*, as all *Volatile Alcalies* Aromatiz'd are.

The effect of *Alcalies* upon *Sulphurs*, confirms us in this Sentiment. For *Alcalies* do diſſolve *Sulphurs*, by ſeparating their parts one from another, and by this means hinder their branches from grapling together. For this cauſe the Interſtices or Intervals of the branches are repleniſht with *Ætherial matter*, as well as the Pores which remain between the *Sulphurs* and the *Alcalies*; which being larger than if the Liquor were ſimply *Alcaline* or *Sulphureous*, do alſo contain within them much more of *Ætherial matter*. And for as much as this *Ætherial matter* is highly agitated, it moves with much

force

force all the parts of this Liquor, which contributes not a little to its activity and its subtility.

The fifth Discourse.

Of the Muscles.

WHen we follow the *Nerves* and *Arteries*, we find that the most part of their branches do lose themselves into *Carneous Bodies*, which are covered over with a most delicate Membrane, and are called *Muscles*.

Three sorts of parts do enter into their Composition. 1. We discover in them a great many *Arteries* and *Veins*. 2. *Nerves*, and in fine, small *Fibres*, which are neither *Arteries*, *Veins* nor *Nerves*, but which are certain small long *Filaments*, most delicate, and yet very strong.

The manner after which they are ranked in the *Muscles*, has something in it very re-

remarkable. At firſt we find them all gathered together, and then they reſemble a ſtring. Afterwards they ſeparate from one another, and receive amongſt them diverſe branches of *Arteries* & *Veins*. In fine, they unite together, and make again a Cord. The firſt and the ſecond Cords are called *Tendons, or the Head and Tail of the Muſcle*. And that part which is plac'd between the Head and the Tail, and which is the place where the *Fibres* of the *Tendons* ſeparate from one another, and where they receive the Veins and Arteries amongſt them, is called the *Belly of the Muſcle*.

Theſe *Fibres* are all parallel, both in the *Tendons* and in the *Belly*. In the *Tendons* ſome of them are longer than others, and in the *Belly* all are of the ſame length. By the order they are plac'd in, they make an *Obliquangular Parallelogram* in the *Belly* of the *Muſcle*. And they are ſo cloſely preſt together in the *Tendons*, that they reſemble two Strings, which draw the *Obliquangular Parallelogram* by its oppoſite

posite sides, as may be seen in this Figure.

A. B. represents a *Tendon*, or the head of a *Muscle*, B. C. the *Belly*, and C. D. the other *Tendon*, or the *Tail*.

The *Arteries* and *Veins* which are spread through the muscle, are not to be found but in its Belly; if they be found sometimes in the *Tendons*, they are so few, that they are not to be regarded. So the *Tendons* are nothing but the Assemblage of the simple Fibres, which for this wee shall call the *Tendinous Fibres*. whereas the Interstices, which are amongst them in the Belly of the muscle, are all repleniſht with *Veins* and *Arteries*.

From

From hence comes the difference, which we obſerve between the colour of the *Tendons* and that of the Belly of the muſcles. The *Tendons* are Brown and the Belly is Red. And it is this part of Animals compoſed of *Tendinous Fibres* and of *Veins* and *Arteries*, which wee call *Fleſh*.

Therefore we muſt not imagine that *Fleſh* is Red of its ſelf, no more than we are to beleive that a Glaſs full of red Wine is red of its ſelf. But rather as the Glaſs appears Red, becauſe the Liquor that is within it is of that colour, even ſo *Fleſh* and all the other parts of the Body of an Animal appear Red, only becauſe of the Redneſs of the Blood which is contain'd in the *Veins* and *Arteries* of theſe ſorts of parts.

This truth is demonſtrated by an Experiment which renders it Inconteſtable. That is, if you make Injections of warm water into the *Arteries*, which ſpread their Banches through the Fleſh, after you have repeated frequently the Injection, the *Fleſh* becomes of the colour of the *Tendons*

The

The *Muscles* are not only composed of *Arteries*, *Veins* and *Tendinous Fibres*, but the *Nerves* also make one of their parts. They march first upon their Coat and pierce it. When they have pierced it, they divide themselves in most delicate Branches, which are inosculated with the *Tendinous Fibres*. Sometimes the *Nerves* enter into the *Tendons*, and sometimes into the *Belly* of the *Muscles*. But in what part soever they enter we find alwayes the extremites of their Branches to end at the *Tendinous Fibres*.

All these *Tendinons Fibres* have a Cavity that goes through them, like unto a Tube or Pipe. Indeed this Cavity cannnot be seen by the eye, but there is an Experiment which abundantly shews the necessity of it, that it cannot be Contradicted by those who will hearken to reason. The Experiment is that alwayes when a *Muscle* acts, its *Fibres* are considerably shortned, and in the mean time they swell bigger. Nevertheless we cannot conceive how flexible *Fibres* can swell bigger, and be shortn'd, at the same

ſame time, but by the means of ſome Liquor which fills a Cavity that pierces them from one end to the other.

After this it will not be very hard to diſcover how all theſe things muſt act. Each *Tendinous Fibre* receives a Branch of a *Nerve*; and each branch of the *Nerve* ſheds animal Spirits into the Cavity of the *Tendinous Fibre*. The Animal Sprits are the moſt ſubtil and the moſt agitated parts of the Blood. When they enter into the Cavity of the *Tendinous Fibres* they blow them up and ſhorten them. Even as the Air which is blown into a bladder, ſwells it and ſhortens it at the ſame time.

If we conſider after this, that the Belly of the *Muſcle* is ſtuff'd throughout with *Arteries* and *Veins*, we will grant that the *Tendinous Fibres* cannot be blown up without diminiſhing the Cavities of the *Arteries* and *Veins*, from whence it follows that the Blood is driven out of them. It is for this that in ſome Animals the *Muſcles* become white alwayes when the Animal Spirits do dilate the *Tendinous Fibres*.

If

If in fine, we take notice that when the Blood ſtops in the *Arteries* and *Veins*, the *Tendinous Fibres* do not receive enough of motion from the Animal Spirits to thruſt forward that Bloud which ſtayes amongſt them. From hence it follows, that in ſuch rencounters they cannot dilate nor become ſhorter.

From hence we may conclude, that there are two things abſolutly neceſſary for the blowing up of the *Tendinous Fibres* of the *Muſcles*. the firſt is, that the *Animal Spirits* muſt have their free courſe through the *Nerve* which goes to the *Muſcle*. For ſince the *Tendinous Fibres* are not blown up but by them, it is clear, that if their courſe be interrupted that they cannot flow into their Cavity, they cannot dilate them. Experience confirms this, in that if you cut or tie a *Nerve* with a threed, the *Muſcle* which receives branches from it, becomes flaccid, and do what you will its *Fibres* do not ſwell.

The ſecond thing needfull for the blowing up of the *Fibres*, is the free courſe of the

the Blood through the *Arteries* and *Veins* of the *Muſcles*. For ſince the *Tendinous Fibres* cannot be dilated without ſtraitning the *Arteries* and *Veins*, and the *Arteries* and *Veins* cannot be ſtraitned without voiding the Blood that fills them, it is viſible that if the Blood ſtop there, it will hinder the *Tendinous Fibres* from being blown up.

This is ſo true, that if you take a living Animal and tie the *Aorta* four Fingers below the Heart, it becomes paralytick from the ligature even to the Extremities of the feet.

When the *Fibres* of a *Muſcle* are blown up by the Animal Spirits, there are two powers which concur to reſtore them to their firſt eſtate. The firſt is the ſpring which theſe *Fibres* make. For ſince their *Pores* acquire an diſpoſition by their being blown up, the Ætherial matter which does inceſſantly paſs through them, makes an effort to reſtore them to their former eſtate.

The ſecond is the Effort of the *Arterial Blood*, which being pouſſed by the Heart with Vigour, blows up again the *Arteries*

and *Veins*, and at the ſame time ſtraitneth the *Tendinous Fibres*. And as the *Arteries* empty themſelves of Blood when they are ſtraitned by the ſwellling of the *Fibres*, ſo the *Fibres* empty themſelves of the Animal Spirits, when they are put again into their ordinary ſtate, as well by the force of the *Arterial Blood*, as by that of their Spunginеſs.

As to the reſt, the *Tendons* of the *Muſcles* are ordinarly faſtned to ſome *Cartilage*, or to ſome bone. Which is the Cauſe why the ſhortning of the *Tendinous Fibres* makes that part move to which the Tendons are faſtned. It is to be remarked likewiſe, that one of the Tendons is faſtned to an immovable part, and the other to a moveable part; from whence it follows, that when the *Muſcle* is ſhortned the moveable part is drawn towards the immovable.

But for as much as there is not almoſt any motion in one part which has not its oppoſite motion, ſo there is not almoſt any Muſcle which has not its oppoſite Muſcle.

Theſe

Theſe Muſcles which ſerve thus to make oppoſite Motions, are called *Antagoniſts*.

It is to be obſerved, as to the Antagoniſt Muſcles, that when the one is ſhortned, the other is extended. For ſince their action is oppoſite, and that that of the one cannot ſubſiſt at the ſame time with that of the other, the ſhortning of the Muſcle which acts, muſt needs produce the extending of its Antagoniſt.

But for that the ſhortning of one Muſcle draws the Fibres of its Antagoniſt beyond their ordinary length, they muſt needs ſpring back. It is for this reaſon that the action of one Muſcle which has been lengthned by the contracting of its Antagoniſt, is done with eaſe enough. For the Tendinous Fibres can be eaſily contracted again, however they have been lengthned, though there be few Animal Spirits which flow into their Cavity, becauſe the force of the Spirits is augmented by that of the ſpunginеſs of the Fibre.

The sixth Discourse.

Of the Cartilages, Bones *and* Membranes.

WE find in the Body of an Animal many parts which seem to partake of the nature of a Bone, and of the nature of Tendons, in that they are not altogether so hard as the former, and are less soft than the other. They call them *Cartilages.*

The first thing which makes me conjecture that Cartilages are nothing but a composure of Tendinous Fibres which are hardned by being repleniſht with Volatile *Alcalies*, is that there is no Cartilage in which many Tendinous Fibres are not loſt. That which makes my conjecture probable, is, that we see by the eye, that the substance of the Cartilages is nothing but a heap of Fibres. And that which puts the thing out of doubt, is, that in young Animals many parts which were Tendinous become at length Cartilaginous; And that

we obſerve frequently in old Animals, that certain Tendons are chang'd into Cartilages.

As Tendons are chang'd at length into Cartilages, the Cartilages are likewiſe changed into Bones. If therefore we have concluded the Cartilages were nothing but a compoſure of Tendinous Fibres, for that the Tendons are ſometimes chang'd into Cartilages; we are obliged by the ſame reaſon to judge that Bones are nothing but a Compoſure of Tendinous Fibres, which after having been hardned to become Cartilages, are afterwards ſo far hardned as to make Bones.

The Obſervations which are made upon the Bones of *Fœtus*'s do demonſtrate this Truth to the Eye. In effect, we obſerve there a great many Tendinous Fibres, and particularly in the Scull. It appears in the beginning, as if it were nothing but a Membrane compos'd of Tendinous Fibres. It becomes afterwards Cartilaginous, and in fine is chang'd entirely into Bone. After which it cannot be doubted, but that Bones

are a heap of Tendinous Fibres, which are hardned after such a manner, that they acquire the firmness of Bone.

Tendinous Fibres are hardned, by being replenisht at length with *Volatile Alcalies*. The Fibres of the Nerves do shed into their Cavity Animal Spirits. That which is more subtile of them, escapes by the Pores, and the grosser remains. So that at first these Fibres are filled with *Volatile Alcalies* and *Volatile Sulphurs*. Whilst there are Sulphurs there, they appear under the form of a Cartilage; but when the Sulphurs are consumed, whether by nourishing the Fibres, or by escaping through the Pores, or in splitting themselves, they appear under the form of Bones.

From hence it comes that there are no parts in the whole Body of an Animal, from whence we extract so much of *Volatile Alcalies* as from Bones.

In fine, we remark that Bones are all covered over with a Membrane, which they call the *Periostium*. This Membrane

is so strongly fastned to the Bone, that in certain places it is impossible to separate it, but by cutting or renting of it.

When we do examine it narrowly, we find three sorts of parts which enter into its composition; to wit, a great many Tendinous Fibres, many branches of Nerves, and some Arteries and Veins. So that after we have duely considered all, we find that the *Periostium* is nothing else but a Web of Tendinous Fibres of the Bone, Nerves, Veins and Arteries.

And because all the other Membranes have communication with the Bones and with the Tendons of Muscles, and for that they have Tendinous Fibres, Nerves, Arteries and Veins, we judge that all the Membranes which are observed in a living Body, are nothing but a Texture of Tendinous Fibres, Arteries, Veins and Nerves.

The seventh Discourse.

Of the Lymphatick Vessels, *and of the* Lympha.

IT is found that from all the Parts of an Animal, certain small Vessels do proceed, which the Anatomists call *Lymphatick*, because they are full of a clear and transparent Liquor, which they name *Lympha*.

The Membranes which compose them are so delicate, that they are invisible when they are not replenisht. They are inosculated into one another, and so compose big enough Trunks, which are inserted into the Veins.

Those which come from the Head, and from the Neck, are inserted in the Subclavian, or in the Jugulars. And the most part of those which derive their Origine from the Inferiour parts, and from the *Viscera* of the lower Belly, do discharge them-

themſelves into one Ciſtern plac'd upon the Vertebra's of the Loins, from whence there goes a Veſſel, which after having paſſed over the Vertebra's of the Thorax, does void its Lympha into the Subclavian Vein.

This Ciſtern is called the *Reſervatory of the Chyle*, becauſe the Chyle which is formed in the Stomach by the Digeſtion of the Meat, comes thither, and the Veſſel which goes from this Reſervatory is called *Canalis Thoracicus*, becauſe it is found couche upon the Vertebra's of the Thorax.

That which is moſt remarkable in theſe Veſſels, is a great quantity of little Valves, which are placed at very ſmall diſtances from one another. They are ſo diſpoſed as that they permit the Lympha eaſily to run towards the Veins, but they hinder it from coming back again, and from flowing towards the parts from whence the Lymphatick Veſſels do proceed.

From whence we may certainly conclude that the Lympha does not come from the Veins but from the parts from whence the

the Limphatick Vessels do derive their Origine. Which agrees perfectly with experience; for if you tie with a threed any Lymphatick Vessel, the Limpha does so abound between the Ligature and the part from whence the Vessel comes, that it blows it up prodigiously; and is so emptied between the Ligature and the Veins whether it is going to discharge its self, that there it becomes invisible. From whence it follows that the use of the Lymphatick Vessels is, to carry into the Veins the Limpha which they have received from all the parts of the living Body.

Wee have not hitherto discovered any Vessel which brings any thing to the parts of the living Body, but Arteries and Nerves. The Arteries bring Blood and the Nerves Animal Spirits. It must needs therefore be, that the Lympha comes either from the Arteries alone, or from the Nerves alone, or from the Arteries and Nerves together. It does not seem to come from the Arteries alone; for if you cut the Nerves which go to one part, there does not flow so much

Lympha

Lympha in the beginning, and diminiſhing by little and little, in fine, it ceaſes entirely. Neither does it come from the Nerves alone, ſince if you tie the Arteries which carry the Blood to one part, it ceaſes by little and little to furniſh Lympha. It muſt needs be therefore that the Lympha come partly from the Arteries, and partly from the Nerves. And conſequently it muſt be compoſed of a part of the Arterial Blood and of the Animal Spirits.

The Lymphatick parts which come from the Blood, paſs after the ſame manner, as the particles of the Liquors which flow from the Glandules. For as theſe paſs from the Blood by being engaged in certain Pores of the Arteries, even ſo the Lymphatick particles finding in the Arteries ſmall Holes through which they may paſs, they are engaged in them. But becauſe they are followed by others which preſs them forwards, they get out and paſs into the Fibres of the parts from whence the Lymphatick Veſſels come.

Theſe which come from the Nerves do

not

not get out by this Artifice. The Nerves insert their Filaments into the Tendinous Fibres of one part, and shed the Animal Spirits into their Cavity. The Fibres have Pores through which they escape, and mingle themselves with what runs from the Arteries, to compose the Lympha by their mixture.

Since we have establisht in the discourse of Nerves that the Animal Spirits are no thing but a Sulphureous Alcalie, we may well think that the Lympha is nothing but a Composure of Volatile Sulphurs, Volatile Alcalies and a little Phlegm. The Volatile Sulphurs, and Volatile Alcalies are the Animal Spirits which enter into its composition; and the Phlegm with the fixt Sulphurs are those of its parts which come from the Blood by the Pores of the Arteries.

An Experiment which succeeds always, confirms this Sentiment. That is, if you gather of the Lympha in a Silver Spoon, and place the Spoon on the Fire, as soon as it begins to warm, there goes from the Lympha

Lympha a ſmall Vapour, and then it hardens like the white of an Egg that is boil'd.

I ſay this Experiment confirms, that the Lympha is nothing but a Compoſure of a great deal of Fixt Sulphur, a little of Volatile, a little of Phlegme and much Volatile Alcalie. For the Lympha is fluid, whilſt the Volatile Alcalies keep its Sulphurs diſſolved, and it hardens like the white of an Egg, how ſoon the Fire has exhal'd them. For then the Fixt Sulphurs being alone, do ſo entangle their branches one with another, that they cannot move after the manner that is needful to compoſe a Liquor. As to the Volatile Sulphur and the Phlegme, it cannot be denied but there is of them in the Lympha; for that the Animal Spirits which compoſe a part of it, are made up of them. and the Vapours going from the Lympha, when ſet on the Fire, do ſufficiently reſemble the Vapours of Water.

We conclude from this, that the uſe of the Lympha is to nouriſh the parts, between the Fibres of which it flows. As will

will appear plainly enough after what we are going to say of Nutrition.

It is a truth well enough known, that many Particles of our Bodies are separated and do exhale; and because these parts go out by the Pores of the Skin, as if it were a most subtile Wind, they call this *Transpiration*.

The parts which pass from our Bodies by Transpiration, are ordinarily Salts dissolved in Phlegmes, with which there are some Sulphurs mingled. They are separated from the Blood by the means of an infinite number of small Glandules, which are situated under the Skin, and whose excretory Vessels end at small Holes, which are on the Surface of the Body, and which we call Pores.

These Glandules which we shall call Subcutaneous, do receive Arteries, send forth Veins, and have some Filaments of Nerves. So that judging of them by others, we may well think that their use is, to separate from the Masse of Blood the Saline parts, which are formed there by the Con-

junction

junction of the *Acids* and *Alcalies*. Which makes us conclude that the parts which paſs away by Tranſpiration, are parts of the Humours of the living Body, and not Particles of its ſolid parts.

The *Acids* which are mingled with the Humours paſs away, not only when they are joyn'd with the *Alcalies*, but alſo when they are joyn'd to the *Sulphurs*. The Author of the *Animal Oeconomy*, has put a conſiderable number of Glandules in the Membrane, which cover the thin Leafs of Bone in the Noſe, which are proper to ſeparate from the Blood the *Sulphurs* united with *Acids*. It is for this that there runs from the Noſtrils a Glewy and whitiſh Liquor.

By this we ſee after what manner the *Alcalies*, *Sulphurs* and *Phlegmes* of our Humours are conſum'd. Which makes us think that they would be very ſoon ſpent entirely, if they were not repair'd. And it is this reparation of the Humours which we call *Nutrition*

The Animal Body is never better nouriſht, than when all its parts are full of Hu-

Humours which Circulate, or are in motion. And becauſe it is the Lympha which flows amongſt the Fibres of the ſolid parts and fill up their Interſtices, it is this alſo which is that Humour whoſe abundance makes Nouriſhment.

The eight Diſcourſe.

Of the Mouth.

EVery Body knows, that the Mouth is that Cavity which all Animals have in their head; and through which the Aliments do enter into their Body. In it four principal things are taken notice of; which are, the Teeth, the Palat, the Spittle and the Tongue.

But before wee enter to enquire into theſe things, it will not be impertinent to remark, that the Mouth is made by the upper and the under jaws. The moſt part of Animals open the Mouth by putting down the nether Jaw, and they ſhut it by

by taking it up. The Contrary is obſerved in Crocodiles, Serpents, and Lizards.

The ſides of the Jaws are pierced with many Holes of a good depth. They receive into their Cavities the roots of thoſe little Bones, which are more poliſht, more white and hard than others, which adorn the entry of the Mouth like to a Paliſſade, and are called *Teeth*.

That part of the Teeth which enters into the Holes of the Jaws, is called their *Root*, and that which ſtands out is chiefly nam'd the *Teeth*. The Roots are uſually much longer than the Teeth themſelves, which is the Cauſe that they keep firm to the Jaws.

Some have their Roots with three points, others of them with two, there are many of them alſo which have but one. When wee break the Teeth with a Hammer, wee find in the Body of them an empty Cavity, which extends its ſelf even to the Root.

The Teeth are not only fixt to the Jaws by their Root, but they are likewiſe faſt-

ned to them by a hard and firm Fleſh which covers their ſides, and whoſe Fibres are extended from one end of the Jaws to the other. This Fleſh is called the *Gums*.

Moreover the Teeth are of three ſorts. Thoſe which are plac'd in the entry of the Mouth are broad, and their extremities made with an edge. They are called *Dentes Inciſivi*. The other which are farther within the Mouth, and which the Cheeks cover, have a thick, ſtrong and large Body, and their extremities broad and unequall, which makes them fit to break and bruiſe. It is for this they call them *Dentes Molares*, or the *Grinders*. And there are yet others which are very ſtrong, and have their Extremities pointed, and are moſt fit to hold any thing faſt. There is alwayes one of them plac'd on each ſide, between the Inciſive and the Grinders, and they are called the *Dog-Teeth* or *Eye-Teeth*, becauſe they receive a branch of a Nerve from thoſe which move the eye.

The number of the Teeth is not alwayes the ſame. Some men have 14 in each

each Jaw, ſome have 15 and others 16. Uſually they reckon four Inciſive, two Dog-Teeth, and eight Grinders, as well in the upper as the neather Jaw.

From all this we may Conclude, that the Teeth ſerve to chew the Aliment. The Inciſive cut it into little Morſels, and the Grinders break and bruiſe it into very ſmall peices, to the end it may paſs forwards, and the Dog-Teeth cut it in peices, when the Inciſive are not ſtrong enough for this effect.

The Palate is that part of the Mouth which makes its Roof, and which is extended from the upper Jaw-bone even to the bottom of the Mouth. The ſurface of it is unequal, and its Fore-part cut into ſmall narrow furrows, plac'd near one another, from the Inciſive Teeth to the middle of the Mouth and its hinder part is of a pretty even ſurface

It is furniſht outwardly with a very delicate Coat, under which there is another more thick and ſtrong. when this is raiſed wee diſcover an almoſt infinite number of

small Glandules. These, being form'd like the Grapes of Raisins make up the Body of the furrows of the Palate. Their Excretory Vessels do pierce the membrane which covers the membrane which covers the furrows, and shed into the Mouth a pretty clear and somewhat viscuous Liquor. The hinder part of the Palat, whose surface is even, hath under its membranes small Glandules of the bigness of the Grains of Millet. They differ from those which make the furrows of the Fore-part in this, that they are not ranked about their Excretory Vessels, as the Grains of Raisins about the stalk of the Grape: but they peirce the Membranes of the Palate by as many Excretory Vessels, as there are Glandules. All these Glandules of the Palate receive Arteries from the Garotides, send Veins to the external Jugulars, and receive Filaments of Nerves from the seventh pair.

We find at the bottom of the Palate three remarkable Bodies, to wit, two Glandules, on each side one. They call them

them the *Almonds*; and between these Glandules a small piece of Flesh of a Conical Figure, which they call the *Avula* or *Pape*.

The Almonds are Vesiculare Glandules of a Yellowish colour. Though they seem two in number, yet they are but one, the middle of which is covered by the Membrane of the Palate, and the Extremities appear like two Lobes. This middle part which makes the Communication of the two Lobes, is both more strait and more delicate, than the two ends of this Glandule.

Each Lobe has a *Sinus* or Cavity, which is divided in many Appartments, the Excretory Vessels of these small Vesicles tend thither, and shed a glewy and whitish Humour, which is not unlike to the Snot of the Nose. They receive Arteries from the Vertebrals, they send Veins to the Jugulars, and their Nerves come from the third, fourth, and fifth pair.

As for the Uvula, it is nothing but a small bag of the Membrane of the Palate.

It hangs between the two Lobes, which make the Almonds. This Bag is full of an infinite number of ſmall Veſiculat Glandules, which are of the colour of the Fleſh, becauſe of the great number of Arteries which they receive from the Vertebrals and the Carotides, and the many Veins which they ſend to the Jugulars. Their Excretory Veſſels do peirce on all ſides its outward Membrane, and bedew it with a Tranſparent & ſomewhat viſcuous Liquor.

The Mouth is not only watered with the Liquor which flows from the Glandules of the Palate and the Uvula, there are likewiſe four other great ſtreams which empty themſelves into it. They diſcharge themſelves of a ſweet and Tranſparent Water, in which there is ſome Viſcoſity remarkable. This Liquor is called the *Spittle*.

We find within the Mouth two ſmall Holes, the one on the Right, the other on the Left ſide. They peirce the Cheeks towards the Molar Teeth, or Grinders: And becauſe we find them alwayes wet, we make no doubt but they are the opening of two ſtreams of Spittle. And

And indeed if we put into them a Bodkin, we find that it goes without difficulty into a ſmall Membranous Pipe, which extends its ſelf alongſt the Cheeks, and is divided into many ſmall Branches when it approaches below the Ear. This Veſſel is always found full of Spittle, and the ſmall Branches which are at its riſe, do loſe themſelves into a heap of Vaſcular Glandules. Theſe Glandules are placed about the Inner-part of the Ear, they are called *Parotides*. So that the ſmall Excretory Veſſels which go from each Glandule coming to be inoſculated together, make up Veſſels ſomewhat larger. Theſe larger Veſſels joyning together do compoſe a greater, which encreaſeth according as it approacheth the Mouth, where it empties the Spittle which the Parotides have ſeparated from the Blood.

Moreover the Parotides do receive their Arteries from the Carotides, and ſend Veins to the External Jugulars; there are amongſt them many Branches of Nerves which come from the hard portion of the ſeventh pair.

The opening of the two other ſtreams which do diſcharge the Spittle into the Mouth, is to be ſeen under the point of the Tongue towards the inciſive Teeth. They are ſo ſmall that they cannot admit a Hogs Briſtle. They appear at the end of two fleſhy *Papillæ*, which ſerve them for ſmall Sphincters. They extend themſelves alongſt the Tongue, and when they come near its root, they are divided into many Branches which loſe themſelves in a heap of Glandules, which are called the *Maxillar Glandules*.

They are placed within the under-Jaw, and they extend themſelves from the root of the Tongue even to the Chin. The part of this Conglomerated Glandule which comes neareſt unto the Parotides, is groſſer and more red than the reſt. As it advanceth towards the Chin, it diminiſheth, ſo that it becomes by little and little more narrow and ſlender. There is remarked towards its middle part a little ſtrait, which joyns its fore-part to the hinder. And afterwards, after having encreaſed conſiderably,

derably, it extends its self even to the Chin, under the Figure of a Quince.

All the Glandules which compose it are nothing but a Convolution of Vessels, which are Inosculated in one another to make by their Concourse two considerable Canals. These Canals extend themselves on each side, on the side of the Tongue, and end at the two *Papillæ* fastned to the Gums, near the two incisive Teeth, within the Mouth.

The Maxillar Glandules receive their Arteries from the Carotides, they send Veins to the Jugulars, their Nerves come cheifly from the third, fourth, and seventh pair. They separate from the Blood the spittle, and the Vessels of which wee have been speaking do empty it in the Mouth.

Besides the four streams of spittle, we remark also many small Rivulets of it which are within the under Lip and alongst the Gum on the inside of the Mouth. It comes from some Glandules which are found engaged amongst the Carneous Fibres of these parts, and whose Excretory Vessels

Vessels pour into the Mouth the Liquor which they have separated from the Blood.

The little Viscosity that is remarked in the Spittle makes us think that it is composed of some Sulphurs, some acids and much Phlegms with which there are some Salts. It mingles with the Aliments in the Mouth, and facilitates the Chewing by Moistning of them. It renders them more fluid, and by consequent fitter to pass through the Conduits which must carry them elsewhere. It may be said also that by its acids and salts, it opens their small parts and makes the beginning of a dissolution. The Sulphurs enwrap its acids by a marvellous precaution of the Author of the *Animal Oeconomy*, to the end they may not corrode the parts which must be watered with Spittle.

The necessity of the mixture of Spittle with the Aliments appears in that all concurs to make it. The Aliments press the Palate, and so oblige the Spittle which its Glandules contain, to run into the Mouth, by the little Excretory Vessels, which

peirce

peirce its Membrane. The Crotaphite Muſcle and the Maſſeters, by ſtraitning and dilating themſelves preſs the Parotides, and through their Veſſels make two little ſtreams of Spittle to run which enter on the right and left Side into the Mouth. The Digaſtrick by its contraction and dilatation agitates the Maxillar Glandules, and preſſes the Spittle out of them, which runs through their Excretory Veſſels like two little ſtreams, which diſcharge themſelves into the Mouth. And whereas in the time of chewing all theſe parts play together after the manner we have ſaid, it muſt needs be granted that this mixture of the Spittle with the Aliments is moſt neceſſary.

In fine, we muſt examine the Tongue, which is a peice of Fleſh almoſt of a Conical Figure. Its Baſis is faſtned unto the bottom of the Mouth by a little Bone which they call *Os Hyoides*. And from its Baſis even to the middle it is faſtned by its under part to the Muſcles, which fill the Cavity of the Under-Jaw, ſo that its point is free, and does not cleave to any part. Un-

Under the free part of the Tongue there is a small Line made of small Tendinous Fibres, which reach from one end, even to the place where the Tongue ceaseth to cleave to the parts which fill the Cavity of the Under Jaw. This small Line is called the *Bridle*.

The Hyoides Bone is plac'd in the bottom of the Mouth at the Basis of the Tongue. It has the Figure of a very open Fork, whose Arms cleave to an heap of Cartilages, which they call the *Larynx*. It is composed of many little Bones, which are joyn'd by Cartilaginous knots. Sometimes there are but three of them, and at other times they reckon thirteen, to wit, six on each side. As for the Bone in the midst to which the Tongue is fastned, it is big in compare with the rest, which are very slender, It is likewise somewhat broad, bunching towards the Tongue and hollow towards the Larynx. On its raised side it has two small appendages which are ordinarily Cartilaginous. They call them the *Horns of the Bone Hyoides*.

There

There are five pairs of Muſcles which do make it move with the Tongue. The firſt is the *Genihoidien* which has its riſe from within the Chin, and reaches to the Baſis of the Bone Hyoides. Theſe Muſcles ſerve to raiſe it by the ſhortning of their Fibres. The ſecond is the *Sternohoïdien*. It comes from the top of the *Sternum*, aſcends alongſt the *Arteria Trachæa*, and is faſtned to the Baſis of the Os Hyoides. This pair of Muſcles draws it downwards. The third is the *Milohyoïdien*. It ariſes from within the Under Jaw towards the Hammers, and is inſerted into the Baſis of the Os Hyoides, which draws it up taking it by the ſides. The fourth pair is the *Coracohyoïdien*. It comes from the Coracoide Apophyſis of the Omoplate. Theſe have two Bellies, and are inſerted into the Horns of the Os Hyoides, which they draw downwards, taking it by the ſides. The fifth is the *Stilo Ceratohyoïdien*. It ariſeth from the Apophyſis Stiloïdes, and is inſerted into the Horns of the Os Hyoides: Theſe Muſcles reſtore it to its ordi-

nary

nary Situation, when it has been mov'd by others. They are peirced to give passage to the Digastrique.

As for the Tongue, it is covered with an outer Membrane, which may be taken for the Cuticula. We find under it a substance which seems Viscuous. It is moderately thick, white on the side that touches the outer Membrane, and black on the other. They call it the *Reticular Body*. This Reticular Body is peirced like to a Sieve, and there ariseth from each of its Holes small Conical Bodies of a pretty hard Substance. They appear in an extraordinary manner on the Tongue of Cats. They are very long and crooked towards the point of the Tongue, like so many little Horns. We remark them also on the Tongues of Oxen and of other Animals of the same bigness. When those small Conical Bodies are pluck'd off, they leave considerable Holes in the Reticular Body, and their covers remain in the outer Surface of the Tongue.

Under the Reticular Body, there is a Coat woven of Tendinous Fibres, and Fi-

laments

laments of Nerves of the fifth, and ninth pair, upon which appears a prodigious quantity of ſmall Nervous Papillæ. Each of theſe Papillæ is covered with one of thoſe Conical Bodies of which we have ſpoken. They peirce the Reticular Body, and terminate upon the Surface of the Tongue.

Upon the Tongues of men there are none of thoſe Conical Bodies which are chiefly remarked on the Tongues of four-footed Animals. But the Papillæ paſs even to the outer Coat of the Tongue, which they elevate in little heights, and thereby render its Surface very unequal.

They reckon three kinds of Papillæ both on the Tongues of men and on thoſe of Oxen, *&c.* The firſt are made like to the Horns of Snails, they have on the top a ſmall round head. They are not numerous, ſome are placed on the ſides of the point of the Tongue; there are none of them above, and many of them are found on the ſide of its Baſis. The ſecond are divided into ſmall Fibres, which loſe themſelves

in

in the risings of the outer Coat of the Tongue, and they are plac'd on its upper part. The Third are Conical and wee find them placed confusedly amongst the rest. They rise all from the Papillar Bodies, they peirce the Reticular Body, and go to the outer Membrane of the Tongue, which they elevate in heights in men, and there they rencounter the roots of the Conical Bodies in Oxen and other Animals which have them.

In fine, the Tongue has five orders of Fibres by which it makes all its motions, besides those which are performed by the Muscles of the Os Hyoides. The first is of those which are extended in a straight line from its Basis to its point, passing through the middle of its Body: by their Contraction they serve to draw its point towards the Base. The second is of those which passing from its Base even to its point, do furnish its two sides. By their Contraction, they move the Tongue to the right and left. The third is of those which passing from one side to the other,

are

are interlaced with the first and cut them at right Angles. When they are shortned they make the Tongue round. This appears much more towards the point of the Tongue than elsewhere. The fourth is of those which coming from its Basis do embrace a part of the Tongue; they are interlaced with the Fibres of the first and third Order, cutting them obliquely. The effect which the shortning of them produceth, is that they draw the Tongue backward, without shortning it considerably. And the fifth is a few Fibres which derive their Origin from the Chin, and are inserted into the under part of the Tongue; they ascend even pretty far into its Body. When they are shortned, they draw the Tongue without the Mouth.

Towards the Base of the Tongue, we remark many small Glandules, situated amongst its Fibres. They have Excretory Vessels, which yield Spittle into the Mouth, and whose Orifices do appear in many places of its Surface. Besides these, there are likewise some others observed

situated on the sides of the Tongue, they call them *Sublinguales*. They have many Excretory Vessels, whose Orifices do appear on the Gums towards the Hammers. There runs from them, as from the rest a clear Transparent, and somewhat viscuous Liquor.

The Fibres of the Tongue do shew us that its use is to agitate the Meat in the Mouth, and to make it pass by its different motions, sometimes under the Grinders to be divided and broken. And as by all these motions it strikes the Palate, agitates the Maxillar Glandules, and that its proper Glandules are prest from time to time, it obliges all its Glandules to yield a considerable quantity of Spittle into the Mouth. So that it is a great Instrument of Chewing.

And in fine, when it is drawn back and raised at the same time by the Muscles of the Os Hyoides, it presses the Meat into a Conduit, called the *Oesophagus*, which comes to the Cavity of the Mouth, and by this means serves to the swallowing of it.

The

The Ninth Diſcourſe.

Of the Oeſophagus.

WHen we trace the Aliments, we find that they go from the Mouth into a Conduit which is extended alongſt the Neck and Breaſt, peirces the Diaphtagma and is inſerted into the Stomach. They call it the *Oeſophagus*.

It is very true that the Aliments paſs over a Cartilage, which covers the Orifice of a Pipe that enters into the Breaſt. This Cartilage is ordinarily lifted up, and the Aliments put it down, when they are thruſt by the Tongue into the Oeſophagus They call it the *Epiglottis*. But becauſe the Aliments paſs over it, without ſtopping there, and it has no uſe as to them, we ſhall not ſtop at it here, but ſhall reſerve to ſpeak of it in another place.

After the Epiglottis the Orifice of the Oeſophagus appears which they call the

Pharinx. It is ordinarily shut, and does not open but to give passage to what is thrust forward that way by the Tongue, or to let out what is voided by the Stomach into the Mouth.

It opens and shuts as is needfull, by the help of seven Muscles. The first is called *Oesophagian*. It is strongly fastned to the two sides of the Scutiform Cartilage, and covers the Oesophagus by its Circuit. Its use is to shut the entry of the Oesophagus.

The others are double. The first are called *Sphænopharingians*. They derive their origine from within the sharp Apophyses of the Os Sphænoides; and are obliquely inserted in the sides of the *Pharinx*, which they open by drawing it upwards.

The second are the *Stilopharingians*. They arise from the extremity of the *Apophyses Styloides* of the Bones of the Temples, and are inserted into the sides of the *Pharinx*, which they dilate by drawing its sides to the right and left Hand.

The third are the *Cephalopharingians*. They

They derive their Origine from the Articulation of the Head with the first Vertebra, and spread their Fibres into the substance of the *Pharinx*, which they shut by the shortning of their Fibres.

Moreover, the *Oesophagus* extends its self in a straight line from the *Pharinx* to the Stomach. It is composed of three Coats, which may be called, the inner, the middle, and the outer Coat. The inner is made up of nothing but Tendinous Fibres diversly interlaced. The middle is made up of Carneous Fibres, of which they reckon two Orders, both in Men and in other Animals. In Men the Fibres of the first Order reach alongst from the *Pharinx* to the Stomach, for which cause they are named *Longitudinal Fibres*; and those of the second Order are like to so many little Circles which do encircle the *Oesophagus*, above which the Longitudinals are placed. They are called *Circular*. In Animals, which eat with the Head downward, they have another Position. The two Orders of Fibres go spirally round

about the Oesophagus. And for as much as the one go from the right to the left, whilst the others pass from the left to the right, they do in many places pass one above another. There is somewhat singular in this passing, to wit, That the Fibres which pass in one place above others, do go under them at the next rencounter, at the second they ascend above: And in fine, they pass again under them. The outer Coat is composed of Tendinous Fibres, more subtil and slender than those of the Inner. The inner and outer Coat serve for Tendons to the middle. So that we may consider the *Oesophagus* as a Muscle, whose inner Coat is the Head, the middle the Belly, and the outer Coat the Tail. So that in Men the *Oesophagus* is shortned by the swelling of the Longitudinal Fibres. And it is straitned by the shortning of the Circular. They call that shortning and this contraction of the *Oesophagus* its *Peristaltique Motion.*

In Beasts, the shortning and contraction of the *Oesophagus* is much greater than in

Men, for that the Muſculous Fibres deſcend ſpirally and do croſs one another. For when they ſwell, and by conſequent are ſhortned, whileſt they thereby ſhorten the *Oeſophagus*, they make its Cavity leſs, becauſe by their Action they wreath it.

This *Periſtaltick* motion is made to the end that what has once paſt the *Pharinx* may not ſtop in the Cavity of the *Oeſophagus*. So that we may well affirm, that the *Oeſophagus* is fram'd after this manner, to thruſt the Meat forward by its Periſtaltick motion, even into the Stomach.

In Beaſts the Periſtaltick motion of the *Oeſophagus* ſtraitens its Cavity much more than in Men, for that they Eat ordinarly with their Head downward. There is therefore more force needful to make the Meat aſcend through the Oeſophagus, that it may go into the Stomach.

In fine, this Periſtaltick motion is called *Vermicular*, becauſe the Oeſophagus moves as Worms do, by ſtraitning and ſhortning its ſelf in one place, and ſwelling

in another, which is continued from one of its ends even to the other by Undulation. The cause of this may be, that the Filaments of the Nerves do enter obliquely into the Tendinous Fibres of the Coats. For as soon as the Animal Spirits were entered into one Fibre, they would be shut up by blowing up the end of the Nervous Filament from whence they come. And so shutting the door upon others, they would hinder more from flowing in, till the Fibres were restored to their former Estate by the force of their spring. And in as much as the Longitudinal Fibres are all of a piece, and the circular ones communicate all together by the small Tendinous Fibres, the animal Spirits passing farther into the Longitudinals, and running into the neighbour circular ones, they would produce there the same effect which they had done in the former. So that continuing to run thus from the one end of the Oesophagus to the other, they would produce a Vermicular or Undulating motion, by which one place becomes more

straitned

straitned and shortned, then is restored into its former estate, whilest this straitning and shortning descends farther, and so of the rest.

The tenth Discourse.

Of the Stomach, *and of* Chylification.

THe Oesophagus is inserted into a kind of bag made almost like a Bagpipe; and this they call the *Stomach*. It is short and open at both ends. The place where the Oesophagus joyns it, is on the left side, they call it the upper Orifice of the Stomach; and the other place where it is open, which is on the right, is called the *Pylorus*.

The inner Coat of the Oesophagus lyes within close about the upper orifice for the space of three inches.

Wee find that the Stomach is made up of three Coats, the outer and inner are woven of Tendinous Fibres, and the middle

dle is made of Carneous Fibres. All between the inner Tunicle and the middle is repleniſht with ſmall Veſicular Glandules. Their Excretory Veſſels peirce the inner Tunicle, & form in its Cavity a ſmall down, for which they call it the *Velvet Tunicle*.

When wee examine the Compoſition of the middle Coat we find ordinarly three orders of Fibres in Beaſts, and two in Men. The firſt is nothing but the continuation of the Longitudinal Fibres of the Oeſophagus, which extend themſelves from the upper Orifice of the Stomach even to the Pylorus. And the other is nothing but the Continuation of the Circular Fibres of the Oeſophagus, which are cut by the Longitudinals at right Angles. Thus it is that they are in men. In Dogs, Cats &c. Beſides theſe two orders of Longitudinal and Circular Fibres, there are two handfuls of Fibres extremely cloſe, which extend themſelves to the right and left above the Stomach, from its upper Orifice even to the Pilorus. They are nothing but the Spiral Fibres of the Oeſophagus which are ſepa-

rated

rated into two handfuls at the upper Orifice, and parting the one from the other, they pass alongst above the Stomach and are reunited at the Pylorus.

All these different orders of Fibres are made to produce a Peristaltick motion in the Stomach. It is by the means of this motion that the Aliments which enter into the Stomach by its upper Orifice, are sent out by the Pylorus.

Moreover the Stomach receives Arteries from the Cæliack, sends Veins to the Splenick and to the *Vena Porta*, the *Parvagum* does furnish it two branches of Nerves considerable enough, and many Nervous Filaments come from the Mesenterical Plexus: and in fine it gives rise to some Lymphatick Vessels which go into the Reservatory of the Chyle.

There would be nothing more to be said of the Stomach, if we did not observe that the Aliments contract a considerable change during the stay they make there. In effect it is observed that they become Liquid and of a whitish colour. This Li-

quor

quor is called the *Chyle*, and the action that produced it is nam'd *Chylification*.

To begin to examine the nature of Chylification. I observe that it produceth fluidity in the Aliments which were solid. We have learned in the Physicks that Fluidity consists in the division and various motion of the Particles of fluid Bodies. So that by Chylification the parts of the Aliments must be separated from one another and diversly moved.

This separation of the parts of the Aliments cannot be done but by bruising or by Fermentation. We know nothing in the Stomach that can so perfectly break and grind the Aliments as is needfull to change them into Chyle. We must conclude then, that this Separation of the parts of the Aliments is made by Fermentation.

We have remarked in our Discourse of the Elements of the living Body, that Fermentation is not made, but by the mixture of two Bodies of a different nature, and that it is done for the most part by the mix-

mixture of Acids and Alcalies. Nevertheless, since Alcalies are needful to dissolve Sulphurs, Phlegmes to dissolve Salts, and Acids to dissolve Alcalies, we cannot affirm that the Ferment which by its mixture makes the dissolution of the Aliments in the Stomach, is only an Acid, an Alcali, or a Phlemge; seing by Chylification, both Salts, Sulphurs and Alcalies are dissolved.

But the Ferment must be composed of Principles capable of making a Fermentation, which dissolves Sulphurs, Alcalies and Salts. And since we have establish'd that Alcalies dissolve Sulphurs, Acids Alcalies, and Phlegmes Salts, we must of necessity conclude that the Ferment of Chylification, is a compoſure of Acid, Alcali and Phlegme.

If the Ferment of the Stomach be such, as soon as the Elements shall begin to mingle with it, its Acids will act upon their Alcalies, and by the Fermentation which they shall excite with them, will begin to dissolve the whole Masse of the Aliments.

ments. The Alcalies of the Ferment coming afterwards to pass amongst the Sulphureous parts of the Aliment, will keep them separated from one another.

And in fine, the Phlegmes after having dissolved the Salts, will find place amongst all the parts of the Aliments, whose union will be broken by the Action of the Acids and Alcalies.

Some difficulty may be raised upon what we have said, that the Ferment of the Stomach was composed of Acid and Alcali; for that these two Principles cannot subsist together without a Fermentation, which would change them immediately into Salt. But if we consider, that certain Acids may have their Angles very pointed, and the sides of these Angles very slender, and that the Pores of an Alcali may be large enough to let the Ætherial matter pass through, though an Angle of these Acids be thrust in there, we will easily comprehend after what manner an Acid may be mingled with an Alcalie without ex-

exciting Fermentation, and without uniting closely with it. For in this case there will be Intervals large enough between the Concavity of the Pores of the Alcalies, and the sides of the points of the Acids which are placed there, to give passage to the matter which flows through their Pores. And since it is the obstacle which this Æthetial matter meets with in its passage, which makes it separate the parts of Bodies, it is clear that it needs not here produce any Fermentation.

When therefore the Aliments descend into the Stomach by their weight; they press the small Glandules, which are placed between its inner and middle Coats. Since they are nothing but little Vesicles, so soon as they are prest they empty themselves, and Distil into the Cavity of the Stomach, a sufficient dew of Ferment, which mingles with what is found there, Ferments it, dissolves it, and makes it Liquid.

That which is Liquified gets above and obeying the Peristaltique motion of the

Sto-

Stomach goes out by the Pylorus. So long as this Fermentation lasts there goes away alwayes somewhat of this sort, and when it is finished the Animal must eat or he is exposed to hunger, which proceeds from this that the Ferment being altogether pure in the Stomach it frets the inward Tunicle.

The Ferment of the Aliments does never entirely dissolve the parts, there are alwayes some of them which escape it. This is the Cause that the Chyle is not to be met with at the going out of the Stomach. and that it is mingled with many gross and useless parts. It is for this reason that nature has made the Chyle to pass through a long Pipe of Intestins, in which it is mingled in divers places with different Liquors, which serve to separate what is good from what might be hurtful to the conservation of the living Body.

The

The Eleventh Diſcourſe.

Of the Inteſtines.

THe Chyle in going out of the Stomach paſſes into a Conduit join'd to the Pylorus, which is called the *Guts*, or *Inteſtines*. This Conduit makes many Circumvolutions: And in fine, after having made many windings, terminates in the Fundament.

They divide them into ſix parts, to which they give different Names. The firſt, which they call the *Duodenum*, begins at the Pylorus, and ends at a place where a yellowiſh and oleous Liquor is diſcharged into the Cavity of the Inteſtines. It is ordinarly repleniſhed with the Chyle ſuch as it comes from the Stomach.

The ſecond, which is uſually found almoſt empty, is called *Inteſtinum Jejunum*. It begins at the end of the Duodenum, and ends at the places where we be-

gin to find Excrements. They give it the length of ten or twelve Palms. The third is called the *Ilium*. It begins at the end of the *Jejunum*, and ends at the ſmall end of a Gut, which is faſtned unto the Cavity of the reſt, like the bottom of a Sack. Hitherto the Inteſtines are very delicate and their Cavity ſmall enough: And it is for this they are called the *ſmall Inteſtines*. The fourth is called the *Cæcum*, which is the ſmall end of a Gut faſtned to the reſt, of which we have made mention. The fifth is called the *Colum*. It begins at the *Cæcum*, and makes a great Circuit about the other Guts: We find at its entry a Membranous folding, whis is ſo framed, that it permits the Excrements to paſs eaſily from the *Ilium* to the *Colum*, but does not ſuffer them to paſs without difficulty from the *Colum* to the *Ilium*. The Cavity of the *Colum* is all divided into little Cells, and it ends at the place where the reſt of the Guts goes ſtraight to the Fundament. This makes the ſixth Inteſtine, which is called *Rectum*. The

Cæcum

Cæcum, the *Colum*, and the *Rectum*, are called the *Great Inteſtines*, becauſe their Coats are ſtronger and groſſer than thoſe of the ſmall Inteſtines.

All the Inteſtines are made up of three Tunicles, as the Oeſophagus of the Stomach. The inner is a Texture of Tendinous Fibres diverſly interlac'd; the middle has two Orders of Carneous Fibres, of which the one are Circular, and the other Longitudinal: And the outer is a Texture of Tendinous Fibres. Theſe Tunicles ſerve to make the Periſtaltick motion of the Inteſtines, after the ſame manner that it is done in the Oeſophagus and the Stomach. This Vermicular motion ſerves to make that which is in the Inteſtines to paſs even to the Fundament, that it may be thrown out of the Body as uſeleſs.

Beſides the three Tunicles of which we have ſpoken, we remark in the ſubſtance of the ſmall Inteſtines, a heap of little Glandules, which ſend their Excretory Veſſels into the Cavity of the Inteſtines, and Diſtill there a clear and tranſparent

Liquor. We ſhall tell its uſe when we ſpeak of the changes which the Chyle receives in paſſing into the Inteſtines.

Moreover the Chyle is not very Liquid when it comes out of the Stomach. It reſembles ſomewhat the Paſte which is made by the Boiling of Meal with Water. It is even like to it of a grayiſh colour, and has much of Viſcoſity. But it does not continue long in that ſtate. It has no ſooner paſt the *Duodenum*, but a yellow and extremely bitter Liquor, which they call the Bile, comes to mingle with it.

The twelfth Diſcourſe.

Of the Bile *and of the* Liver.

WHen we enquire by Chymiſtry what are the Elements of the Bile, we find that it is compoſed of much of fixt *Alcalie*, a little *Volatile*, a little of *Sulphur*, yet leſs of *Earth*, and much of *Phlegme*.

From

From whence we may conclude, that the *Bile* mingling its ſelf with the Chyle, receives in its *Alcalies* both fixt and *Volatile*, a part of the *Acids*, which hold its Sulphurs united together, and thereby keep up the Viſcoſity which it has in the Duodenum. So that the Sulphurs of the Chyle are after this more at liberty, and more ſeparated one from another. Wherefore they receive amongſt their parts, the Phlegme of the Bile, which dilate the whole Maſſe and give it a greater fluidity.

The Bile is diſcharged into the Cavity of the Guts, at the end of the *Duodenum* by a ſmall Hole, round about which is obſerved a ſmall Spongious edge. If you put a Probe into this ſmall Hole, it paſſes into a Membranous Conduit, which reacheth to the Liver. This Conduit is always full of Bile. It is therefore called *Canalis Cholidochus*.

The Inſertion of this Veſſel into the Inteſtines is ſingular enough. At firſt it creeps above the hinder part of the Duodenum, and then peirces its outer Coat. Afterwards

it peirces its middle Tunicle after having deſcended for ſome ſpace between that and the outer Coat. And in fine, after having made ſome way between the middle Tunicle and the inner, it pierces the inner at the place where we have obſerved the little Hole through which the Bile flows into the Inteſtines.

The Obliquity of this Inſertion ſerves to make the Bile run into the Inteſtines. And the ſpongious edge which environs the little Hole hinders the Bile from returning from the Inteſtines into the *Ductus Cholidochus*. For the ſpongious edge is a ſmall Sphincter which keeps the little Hole ſhut, when the Bile does not keep it open by flowing into the *Guts*. And the Periſtaltick motion of the Inteſtines paſſing towards the little Hole, ſerves ſucceſſively that part of the Ductus Cholidochus which creeps amongſt the Membranes of the Duodenum; and thereby obliges all the Bile that is in this part of the Ductus Cholidochus to run into the Cavity of the *Guts*.

After

After having considered all this exactly I follow the Ductus Cholidochus towards the liver, and I perceive that it is forked there, and that one of its branches goes to a Bladder situated besides the concave part of the Liver, whilest the other goes to the Liver. They call the branch which goes to the Bladder *Ductus Cystici*, and that which goes to the Liver *Ductus Hepaticus*, and the Trunck which arises from the joyning of both these which is inserted into the end of the Duodenum, *Ductus Communis*.

The Hepatick Conduit enters into the Liver accompanied with two Arteries, two Nerves and the *Vena Porta*. All these Vessels are shut up in a Membranous sheath, which they call, *Glisson's Capsula*. As soon as they enter into the Liver, they are divided into many branches, and these branches into others, and thus they continue to divide till they be spread through all the substance of the Liver.

It is here to be remarked that all these Vessels continue still to be shut up in *Glis-*

ſon's Capſula. It accompanies them thro' all, and follows all their ramifications. So that wherever there is a branch of an Artery, there is there alſo a branch of the *Vena Porta*, and one of the Ductus Cholidochus, and the whole is ſhut up in a branch of the Capſula. As for the Nerves they follow alſo the ramification of the other Veſſels for ſome ſpace, and in fine they form a ſmall net, which enfolds the *Arterys*.

From this by the way we may conclude that the *Vena Porta* does not beat in the Liver, as ſome Authors have imagined; but that the beating of the Capſula proceeds from the beating of the Arteries which are ſhut up in it.

All theſe Veſſels enter into ſmall Lobes, the Aſſemblage whereof makes up the Liver. Each Lobe is ſhut up in a very delicate Membrane which divides it from all the reſt. Nevertheleſs it ceaſes not to adhere to them by ſmall Tendinous Fibres. The Membrane which enfolds each Lobe degenerates into a part of the Capſula, enfolding all the Veſſels which enter into the

the Lobe. So that Gliſſon's Capſula is nothing but the continuation and re-union of all the Membranes which encompaſſe the ſmall Lobes of the Liver.

All theſe Lobes are made up of little Vaſcular Glandules, which touch one another. Each Glandule receives a branch of an Artery and of the *Vena Porta*, and there goes from it a branch of the Ductus Cholidochus, which is nothing but a continuation of the Veſſel of the Glandule. They are faſtned to theſe ſmall Veſſels as Raiſins to the Trunk of the Grape. There goes alſo from each Glandule a branch of the Hepatick Vein, which being united make up a conſiderable Trunk, which goes from the Liver at its convex part, and enters into the aſcending *Vena Cava*.

The *Vena Porta* and the Arteries bring the Blood to the Glandules of the ſmall Lobes, the branches of the Hepatick Vein carry it away again into the *Vena Cava*, and the Ductus Cholidochus tranſports into the end of the Duodenum the Bile,

which

which the Glandules of the small Lobes have separated from the Blood.

This is what we have discovered in following the Ramifications of the Hepatick Conduit. Let us now trace the *Ductus Cysticus*. I remark first that it is straitned by a small Fibrous Ring at its Insertion into the Vesicle of the Bile. So that this Fibrous Ring performs the office of a small Sphincter, which shuts the entry of the Vesicle, and hinders the Bile which usually fills it, from getting out, unless it be forced. Afterwards I consider the *Vesicula Fellis*. It has the figure of a small Pear, and it receives Arteries from the Cæliack, which are called the *Cystick Arteries*. It is made up of two Tunicles, between which there are a prodigious number of small Vesicular Glandules, which receive branches from the Cystick Arteries. The Excretory Vessels of these little Glandules do peirce its inner Coat, and make within its Cavity a small Down, from whence there flows a very clear and Transparent Bile in form of a Dew. This

Bile

Bile differs from that which flows from the Hepatick Conduit, in this, that the former is of a deeper colour and abounds more in a fixt Alcalie, whereas this is more fluid, and has more of a Volatile Alcalie than the other.

All the Bile which is found in the Veſicula Fellis, does not come only from the Veſicular Glandules ſituated between its Tunicles; but a great part of it comes from the Lobes of the Liver which are about the Veſicle. They diſcharge themſelves into its Cavity by two or three *Ductus Choledoci*, which are inſerted into that part of it that adheres to the Liver. Amongſt the reſt there is one conſiderable enough which peirces the Tunicles of the Veſicula Fellis near the Fibrous Ring. The mouth of this Veſſel is encompaſſed with a ſmall Spongious border, which ſerves it for a Sphincter.

There goes a great number of Lymphatick Veſſels, both from the concave part of the Liver, and from the Veſicle, which enter into the Reſervatory that is placed

placed above the Vertebræ of the Loins.

In fine, the Liver has three Ligaments which keep it in its ſituation. The firſt keeps it ſtrongly faſtned to the Diaphragme, and it peirces into the ſubſtance of the Liver, even to Gliſſon's Capſula. The ſecond is of a good length, it is faſtned to the Liver near the Bladder of the Gall, and it goes to the Navel. The third is ſlack, but ſtrong and large. It derives its Origine from the Membrane which encompaſſes the whole Liver, and which is a production of the Peritonæum, and it goes from thence to the Xiphoid Cartilage.

Its upper part is Convex, and its under Concave, is divided into three or four great Lobes, and by its under part it embraces a part of the Stomach So that when the Stomach is full of Meat, the Bladder of the Gall being then preſt, the Bile goes out by the Cyſtick *Channel*, and runs in abundance into the *Duodenum*, to diſſolve the Chyle according as it comes from the Stomach.

From all this therefore, we may conclude

clude that the uſe of the Liver is to ſeparate the Bile from the Blood, to perfect the Chyle in the Inteſtines, by diſſolving its Sulphurs by its *Alcalies*, and by diluting it with its Phlegme.

The Thirteenth Diſcourſe.

Of the Changes which the Chyle *receives in the* Inteſtines.

BEſides the *Bile* which is diſcharged into the Duodenum; there is alſo another Liquor Clear and Tranſparent as Water, which advances thither, and which they call the *Pancreatick Juyce*. This Pancreatick Juyce is ſomewhat of the ſame nature with the Lympha, that is, that it is compoſed of Sulphurs, Phlegms and Volatile Alcalies.

As ſoon as it falls into the Inteſtins, it mingles with the Chyle. If it rencounters any *Acids* in the Chyle, which keep its Sulphurs united, its Volatile Alcalie charges

charges its ſelf with them, which frees the Sulphurs from the other Principles. The Sulphurs which are in the Pancreatick Juyce, thruſt themſelves amongſt the parts of the Chyle. They moderate the Fermentation of the Alcalies with the Acids, and hinder it from being done with too much Violence, which would occaſion much diſorder. And the Phlegme make way to the Alcalies and Sulphurs, and they mingle more exactly with all the parts of the Chyle.

From all this it follows clearly enough that the Pancreatick Juyce perfects the Chyle and renders it more Liquid. In men the Pancreatick Juyce and the Bile do enter into the Inteſtine at the ſame Hole. And in the moſt part of other Animals the Pancreatick Conduit is inſerted into the Jejunum two Inches below the Inſertion of the *Ductus Cholidochus*. We remark in this Inſertion of the Pancreatick Conduit almoſt the ſame circumſtances which have been obſerved in the Inſertion of the *Ductus Cholidochus*. About the little

little Hole from whence the Pancreatick Juyce flows into the Cavity of the Inteſtines, there is a little Fibrous edge, which ſerves it for a Sphincter, and hinders any thing from paſſing from the Inteſtines into the Pancreatick Conduit.

This Conduit is made of many others, which ſpread through a Glandulous Body, which they call the *Pancreas*. The Glandules which compoſe it, are Vaſcular of a reaſonable bigneſs. There goes from each a ſmall Conduit which is Inoſculated into the Pancreatick Conduit, and ſheds into its Cavity the Liquor which the Glandule has ſeparated from the Blood.

The whole Pancreas is covered with one Tunicle. It receives Arteries from the Cæliack, it ſends Veins to the Splenick, and ſome Ramifications of the Intercoſtal come thither, and ſpread through all its Body.

It is ſo needfull for the conſervation of of the Animal, that the Chyle ſhould be freed of its Acids, that the Author of nature has plac'd many heaps of Veſicular Glan-

Glandules between the Tunicles of the ſmall Inteſtines. They diſtill into theſe places a Liquor like unto the pancreatick Juyce. By its mixture with the Chyle it finiſheth what the Bile and the pancreatick Juyce had ſo well begun.

Theſe ſmall heaps of Glandules are of different bigneſſes. There are of them which contain more than two hundred Glandules, and there are of them again which have not thirty. Sometimes there are four of them, ſometimes five, and ſometimes ſix. Sometimes there are two of them in the Jejunum, ſometimes three, and ſometimes but one: we find alwayes two or three ſuch heaps in the Ilium.

All the parts of the Chyle are not fit to Paſs into the ſmall Veſſels which are called the Lacteal Veins. Some of them too groſs, and theſe are they which are called the groſs Excrements. The Chyle abounds in parts fit to paſs into the Lacteal Veins, after that it has been prepared by the Bile and the pancreatick Juyce. It is for this that its maſſe doth diminiſh

ſo

ſo much in the Jejune Inteſtines for that its more ſubtile parts get out and paſs into the Lacteal Veins. So it is obſerved that there are more Lacteal Veins of the Jejunum, than of all the other Inteſtines. At the end of the Jejunum ſome Excrements are found mingled with many Chylous parts. The Glandulous juyce mingles with them and diſſolves the Sulphurs from the Chylous parts which are there. What has thus been prepared paſſes likewiſe into the Lacteal Veins. Theſe Excrements do afterwards paſs into the Ilium, where in divers places they receive again of the Glandulous Juyce, which doth produce the ſame effect as formerly. In fine, after they are entirely freed of their Chylous parts, they paſs into the greater Inteſtines. They are then compoſed of parts which the Ferment of the Stomach could not diſſolve, and of ſalts which are formed by the union of Alcalies, of the Bile, of the pancreatick Juyce, and of the Glandulous Juyce with the Acids, which were engaged amongſt the parts of the Chyle.

The fourteenth Discourse.

Of the Mesentery, *the* Lacteal Veins, Pecquets Reservatory, *and the* Thoracick Conduit.

THe Intestines adhere to the Circumference of a Membranous Ruffe, which they call the *Mesentery*. The middle of it is so strongly fastned to the Vertebraes of the Loins, that it cannot be separated from them, unless you tear a part of it, or cut it. It is composed of two Membranes, of which the upper is a continuation of the Peritonæum, and the inferiour a Texture of Tendinous Fibres which come from the Vertebraes of the Loins.

The Mesenterick Arterie spreads many branches amongst the Membranes of the Mesentery, one part of which goes to the Intestines, and the other is spread amongst the Fibres of the Membranes which compose it. The Veins which come from the

the Inteſtines are likewiſe ſpread between the Membranes of the Meſentery, and many ſmall Veins which come from amongſt their Fibres, go thither. They are called the *Meſaraick Veins*. They go to the *Vena Porta*. Many Nerves which ariſe from the Vertebraes of the Loins, and from the Intercoſtal, are ſo interwoven one with another upon the Meſentery, that they form a Plexus which is called the *Meſenterick Plexus*. Many Nervous Fibres go from it, which are ſpread amongſt the Fibres of the Membranes of the Meſentery, and a part of which paſſes even to the Inteſtines.

The middle between the Membranes of the Meſentery is repleniſht with Fat. It appears cheifly about the Meſaraick Veins. In the midſt of it we find a large Glandule, and ſometimes two, three or four. In Oxen and ſome other Animals there are many more, and they are plac'd towards the ſmall Inteſtines. The knowledge of the ſtructure of theſe Glandules does admirably ſerve to explain their uſes.

They are a heap of angular Veſicles. There is a communication between their Cavites. This is found by blowing into them after you have thruſt out all that fills them. The Air paſſes from one Veſicle to another, and makes them appear ſuch as we have deſcribed them.

In fine, we diſcover between the Membranes of the Meſentery certain ſmall Veſſels, which come from the Inteſtines and paſs into the Glandules of which we have ſpoken.

Theſe Veſſels are ordinarly full of Lympha, and ſometimes we find them full of Liquor like to Milk. which is the reaſon why they call them the Lacteal Veins.

This Milk is nothing but the pure Chyle, which has paſt from the Cavity of the ſmall Inteſtines into that of the Lacteal Veins. There are four Experiments which confirm us in this Opinion. The firſt is, that the Milk which runs into the Lacteal Veins comes from the Inteſtines, this truth appears to the Eye, when

when the Lacteal Veins are preſt with the Fingers. They empty themſelves of the Milk, and we ſee it come afterwards from the ſide of the Inteſtines to fill the Vein which has been emptied. The ſecond is, that Milk is not to be found in the Lacteal Veins but ſome Hours after the Animal has eaten. The third is, that we find the Jejunum almoſt alwayes empty, becauſe of the great number of Lacteal Veins which goe from it.

Moreover the Lacteal Veins have many Valves, plac'd very near one another. They are ſo diſpoſed that they permit the Chyle to run eaſily into the Lacteal Veins in going from the Inteſtines to the Glandules of the Meſentery, but they hinder its return. They go from the Inteſtines in great number, and they are Inoſculated many of them together according as they advance. By this means they make up ſome greater Veſſels which empty the Chyle that they carry, into the Veſicles of the Glandules of the Meſentery.

The Chyle goes into the Vesicles of these Glandules, to receive there Animal Spirits, which come thither in abundance by many Nerves which proceed from the Mesenterick Plexus. These Spirits render the Chyle more subtile and fluid by their Volatile Alcalie, and if there be any acidity in it, they correct it, by receiving it into their Alcalies and changing it into Salt.

After that the Chyle has past through the Vesicles of the Mesaraick Glandules, it discharges its self into two or three Conduits which arise from under them. They end afterwards in a Membranous bag situated above the Vertebras of the Loins, they call it the *Reservatory* of the Chyle. The Reservatory is the same thing with the Cistern of the Lympha, of which we have spoken before. In this place the Chyle is mingled with much Lympha, with which the Reservatory is alwayes full. It dilates it, and renders it more Liquid, that it may run the more easily.

In fine, there goes from the Reservatory

tory of the Chyle, a Conduit, which is called the *Thoracick Conduit*, for that it goes alongſt the Vertebraes of the Thorax. Sometimes this Conduit is forked, and its branches unite again, ſometimes it is altogether ſimple.

The Thoracick Conduit is inſerted into the Subclavian Vein, above its Inſertion there is a Valve, which like a ſmall Vault covers it. So that the Blood which runs through the Subclavian Vein, runs by without hindring the entry of the Chyle.

When we blow in the Thoracick Conduit, we perceive many Valves in its Cavity. They are plac'd at very ſmall diſtances from one another, and are ſo diſpoſed that they permit the Chyle eaſily to run towards the Subclavian Vein, but they hinder it from deſcending into Pecquets Reſervatory.

From whence we may conclude that the Chyle runs from its Reſervatory by the Thoracick Conduit into the left Subclavian Vein. There it mingles with the

Blood. Whoſe courſe it follows and goes into the *Vena Cæva*, which carries it into the right Auricle of the Heart. The Auricle diſcharges it into the right Ventricle. And whereas the Chyle makes then a part of the Blood, it follows its courſe, and circulats with it through all the Body.

The fifteenth Diſcourſe.

Of the Heart.

WHen the Chyle is once entered into the Subclavian Vein, it mingles its ſelf with the Blood, and follows its courſe. We muſt therefore follow the Blood, if we could know what becomes of the Chyle.

The circulation of the Blood ſhews us that it runs from the Subclavian Vein into the *Vena Cava*, and from the *Vena Cæva* it paſſes into a bag adhering to the right ſide of the Heart. This little bag they call the *right Auricle of the Heart*. When this Auricle

Auricle is full of Blood it contracts its ſelf, and in contracting its ſelf ſheds it into a Cavity which we find in the Body of the Heart on its right ſide. This Cavity is called the *right Ventricle of the Heart.* As ſoon as the Ventricle is full of Blood, it contracts its ſelf, and empties its ſelf by this contraction.

It is here to be remarked, that at the opening of the right Auricle into the right Ventricle of the Heart, there are certain ſmall Skins, which they call Valves. They are three in number, almoſt of a triangular Figure, whoſe ſides are notched. Their Baſe adheres to the opening of the Auricle, and their point is plac'd within the Ventricle. Their point is upheld only by ſmall Tendinous Fibres, ſtrong and of a good Length, which without being ſtretch'd are ſtrongly faſtned to ſmall carneous pillars, plac'd upon the concave ſurface of the Ventricle This diſpoſition ſhews to the Eye that theſe Valves are ſo many ſmall doors, which the Blood opens of its ſelf, when it runs from the Auricle

into

into the Ventricle, and which it shuts after it is entered there. Indeed as soon as the Ventricle is full of Blood it contracts its self, and the Blood is prest equally on all sides by this contraction. For this cause it gets under these Valves, lifts up their point towards the opening of the Auricle, which is thereby so exactly shut, that no drop of Blood can pass that way. So the Blood shuts up to its self this passage, and cannot get out the way by which it has entered. Nevertheless it does not stay in the right Ventricle of the Heart, it goes out by another door, to which the beginning of an Artery is strongly fastned. This Artery is divided into many branches, which distribute themselves into the Lobes of the Lungs. At its passing from the right Ventricle it has in its Cavity three Valves made like Crescents, and ranked each at the side of the other. Their Convexity adheres to the Artery and turns towards the Ventricle, and their Concavity is disengag'd and turned towards the Artery. This situation shews us that they

they do not oppose the motion of the Blood when it comes from the Ventricle to the Artery, but by rising up they stop its course if it press from the Artery into the Ventricle.

After that the Blood has past from the right Ventricle into the Lungs by the Pulmonary Artery, it returns from them by a Vein, which is called the *Pulmonary Vein*. This Pulmonary Vein discharges its self into a little bag, fastned to the left side of the Heart, which is called the *left Auricle*. As soon as this Auricle is full, it contracts its self, thrusts by its Contraction the Blood into a Cavity in the substance of the Heart, plac'd on its left side which is called the *left Ventricle*. As soon as this Cavity is full of Blood it contracts its self, and by this contraction throws out all the Blood which it contains.

That we may learn where the Blood goes when it passes from the left Ventricle of the Heart, we are to take notice that at the opening of the left Auricle there are Valves situated, after the same manner

as

as at the opening of the right Ventricle. Their uſe alſo is the ſame. They permit indeed the Blood to run from the Auricle into the Ventricle, but they hinder it from coming out of the Ventricle into the Auricle when the Heart contracts its ſelf. The Blood therefore takes another way. Indeed it gets out of the left Ventricle by another paſſage, which makes the beginning of the great Artery, which they call the *Aorta*. We find in the Cavity of this Artery next to the Heart, three Valves made Creſcent wayes, diſpoſed after the ſame manner as thoſe of the Pulmonary Artery. They permit the Blood to get out of the left Ventricle and to run into the Aorta, but they hinder the Blood from flowing back from the Aorta into the left Ventricle.

There is yet an important remark to be made upon the motion of the Auricles and Ventricles of the Heart. It is, that the two Auricles do contract and dilate themſelves at the ſame time, and the two Ventricles in like manner. With this Circumſtance,

cumſtance, that at the time the Auricles contract themſelves, the Ventricles are dilated, and when the Ventricles contract themſelves, the Auricles are dilated in courſe. Which makes us conjecture, that the Heart is a Muſcle, whoſe Auricles may well be reputed the Antagoniſt Muſcles.

Before we enquire if this conjecture be a truth, it will not be impertinent to obſerve, that ſince the Auricles contract themſelves at the ſame time, they do alſo at the ſame time ſhed the Blood into the Ventricles of the Heart. By the ſame reaſon the Ventricles of the Heart do at one time preſs the Blood into the Pulmonary Artery, and into the Aorta.

When we conſider the Heart narrowly, we perceive that it is compoſed of Carneous Fibres, which have all of them communication with a Membrane made of Tendinous Fibres. This Membrane is plac'd at the Baſe of the Heart, and keeps the Auricles fixt to it. Which makes us judge that the Heart is a Muſcle.

In the Heart we obſerve three orders of Fibres,

Fibres, the first is, of those which go in a straight line from the Basis of the Heart just to its point; and they lye in a small number over the right Ventricle. The second is of those which go from the Base, and after they have extended themselves to the middle of the Heart, ascend again and return to the Base from whence they came. The third is of those which goe from the Base and come to the point, describing about the Heart a spiral Line. There they re-enter within the Heart, and re-ascend spirally towards the Base. Some of them end in the Ventricles, where they make a Texture of their Tendinous Fibres, which covers them on all sides. Some of those also which come into the Ventricles make those little Eminencies which are called *Pillars*. From the point of these Pillars go many Tendinous Strings, which are joyned to the Teeth of the Valves that are plac'd in the opening of the Auricles.

All these Orders of Fibres do serve by the shortning of themselves to contract the Ventricles of the Heart. The straight Fibres

bres ſhorten it, the circular ones ſtraiten it, and the ſpiral wring it. The Heart cannot be thus ſhortned, ſtraitned and wreathed, but the Ventricles muſt needs be contracted. From whence we muſt conclude, that the Heart is a Muſcle, whoſe action conſiſts in ſtraitning the Cavities which are amongſt its Fibres.

As for the Auricles, they are alſo compoſed of Carneous Fibres, of which ſome of them are interwoven with others. They are extended for the moſt part to the length, and thoſe of them which are interwoven ſeem to croſs them to become Circular. The ſhortning of the firſt does diminiſh the length of the Auricles, and the ſhortning of the other diminiſheth their breadth. Which ſhews us that the Auricles are nothing but Cavernous Muſcles, whoſe action conſiſts in the contraction of their Cavity.

There is a communication between the Fibres of the Heart and thoſe of the Auricles, by the interpoſal of the Tendinous Fibres, which are gathered altogether pure

at

at the Base of the Heart. We may look upon them as a Tendon common to the Heart and the Auricles. The animal Spirits therefore which the Nerves distil into this Tendon, do easily pass from the Fibres of the Heart into the Fibres of the Auricles, and from the Fibres of the Auricles into those of the Heart.

If we would yet form to our selves an Idæa of the Heart as clear and distinct as may be, we may consider it as a Muscle with three Bellies. Each Auricle makes one, and the Body of the Heart makes the third, and the Membrane which is at the Base of the Heart, where the Fibres of the Heart and of the Auricles do meet, would be the common Tendon.

The Heart receives Arteries from the Aorta, it sends Veins to the Cava; it receives Nerves from the plexus Cardiacus and the *Par Vagum*.

In fine, the Heart is shut up in a Membranous Bag which is called the *Pericardium*. The Pericardium is strong and it is formed of a Texture of the Tendinous Fibres

Fibres of the Heart, of ſome Veins, ſome Arteries and ſome Nerves. It contains always a little Seroſity, which the ſmall Glandules that are plac'd amongſt the Fat of the Baſe of the Heart do diſtill into it.

From what has been ſaid, we may conclude, that when the Auricles are full of Blood, the Ventricles of the Heart are empty. And for that the Auricles, how ſoon they are full of Blood, do contract themſelves; the Blood which they preſs into the Ventricles of the Heart, being aided by the ſpring of their Fibres, does dilate them, and conſtrains the animal Spirits to get out of them, and to run into the Auricles to accompliſh their contraction. But as ſoon as the Auricles are contracted, the Blood which advances on all ſides, joyn'd with the force of the ſpring of their Fibres, reſtores them to their former ſtate. And the Spirits paſſing in that moment from the Auricles to the Heart, ſhut it up, and cauſe its contraction. It is for this Reaſon that the Auricles empty themſelves when the Ventricles of the Heart are filled,

and that the Auricles fill themselves when the Ventricles are emptied.

The heart by its Contraction throws the Blood from its Ventricles into the Arteries. But for that the Artery become still narrower, the Blood cannot be thrown out impetuously without swelling them When they are thus blown up, they restore themselves to their former state by the spring of their Fibres, and by this mean make a part of the Blood which they have received run into the Veins of the Heart. And since the Heart throws out the Blood into the Arteries by several strokes, the Arteries must needs be blown up and fall again by several turns. It is this motion of the Arteries which they call the *Pulse*, concerning which it is to be remarked that the dilatation of the Arteries accompanies the contraction of the Heart, and the contraction of the Arteries accompanies its dilatation.

Those who are satisfied with what they conceive clearly, will be contented to ascribe to the Heart the office of pressing the Blood into the Arteries, and of being the prin-

principal Instrument of its Circulation. They may leave to those who believe that the Heart is the Organ of sanguification, the satisfaction they have to be pleased with a conjecture ill founded, as shall be made appear afterwards.

The Sixteenth Discourse.

Of the Lungs.

WE have said in the preceeding Chapter, that when the Blood goes from the right Ventricle of the Heart it passes into the Pulmonary Artery. This Artery is divided into many great branches which enter into the Body of the Lungs, and these branches are again divided into others, and these into others, till at last the smallest of them are lost into the substance of the Lungs.

The Pulmonary Artery is not spread alone in the Lungs. It is every where accompanied with the Pulmonary Vein, a branch of a Nerve which comes from the

Par Vagum, a small Artery which goes from the *Aorta*, and which they call the *Bronchial* Artery, with a small Vein which is passing into the *Vena Cava*, and which they call the *Bronchial Vein*; and a certain Cartilaginous Conduit, which they name the *Bronchiæ*.

The Bronchiæ are nothing but the Ramifications of a great Cartilaginous Pipe, which extends its self from the bottom of the Mouth, even to the Lungs. It lyeth above the Oesophagus, and is plac'd in the fore-part of the Neck. They call it the *Arteria Trachæa*.

There is at the top of the *Arteria Trachæa* a horny part, which they name the *Larinx*. It is made up of five Cartilages. That which takes up its forepart, makes that Eminence which in men they call *Adams Bit*. Its Figure is almost like unto that of that Buckler which amongst the Latines is called *Scutum*. For this reason they name it the Scutiform Cartilage. The second is called the *Annular*. It is made like the Ring which the Turks make use of for draw.

drawing the Bow. It is ſtrait before and large behind. It embraces the whole Larinx, and is faſtned into the Scutiform. The third and fourth are called the *Aritenoides*. They are the productions of the Annular, placed on its hinder part, and ſeparated from one another by a ſmall ſlit. They make that part of the Larinx which they call the *Glottis*. The fifth is a Cartilage faſtned above the upper part of the Scutiform Cartilage. They call it the *Epiglottis*. Its Figure is Triangular, and its ſubſtance ſofter than that of the others. Its Baſe adheres to the Scutiform Cartilage, and the reſt of its Body is diſengag'd from any other part. It is uſually lifted up. This is that Cartilage which the Aliments put down in paſſing from the Mouth, into the Oeſophagus. When it is down it ſhuts the entry of the Trachæal Artery, and thereby hinders the Aliments from going into it.

The *Larinx* is reckoned to have thirteen Muſcles. There are four of them, which are common to it with other parts, and nine which do properly appertain to

it. The first pair of the common ones are nam'd the *Sternothyoidians*. They arise from the top of the *Sternum*, lye above the Trachæal Artery, and are fastned to the inferiour part of the Scutiform Cartilage. When their Fibres are contracted they draw the Scutiform downwards. The second pair is made of the *Hyothyroidians*. They arise from the Base of the os Hyoides and are fastned to the Base of the Scutiform. They serve by the contraction of their Fibres to lift up the Larinx.

The first pair of Muscles proper to the Larinx is made of the anteriour *Cricothyroidians*. They derive their origin from the forepart of the annular Cartilage, and they end at the lower part of the same Cartilage. By their action they dilate it. The second is made of the Posteriour *Cricothyroidians*. They arise from the top of the annular at its hinder part and come to the sides of the Scutiform at its upper part. When they act they straiten the Scutiform. The third is made of the *Cricoarytheno-idians*. They derive their origine from the

the inner, and side part of the annular, and are inserted into the under part and the sides of the Arithenoides. By their Contraction they dilate the *Glottis*. The fourth is made of the *Thyroarithenoidians*, They come from within, and from the middle of the Scutiform, and are terminated in the sides of the Arithenoides, By their action they shut the Larinx. The ninth Muscle is called the *Arithenoidian*. It ariseth from the place where the annular is joyn'd with the Arithenoides which it straitens when it acts.

The Larinx covers the top of the *Tracheal Artery*, whose frame is singular enough. First we find it covered with a very delicate Membrane whose Fibres are diversly interwoven Then under this Membrane there are Cartilaginous rings. These rings are entirely Cartilaginous except on their Back-side, where they are Membranous. It is by this place they touch the Oesophagus. They are not Cartilaginous that they may yeild to the Oesophagus, when any great and hard morsel passes alongst its Cavity.

These Cartilaginous Rings are not all of the same grossness. That which upholds the Larinx is greater and larger than that which follows, and this is larger than the next, and so forward. So that the more they approach the Lungs their breadth diminisheth. They are all united together by carneous Ligaments, and it is remarked that they are all equally distant the one from the other.

When they enter into the Body of the Lungs they are nam'd the *Bronchiæ*. There they cease to be Membranous on their back-part and become entirely Cartilaginous. And whereas in the Tracheal Artery its Rings are equally distant from one another, in the Bronchiæ they are joyned in such a manner as that a part of the Inferiour Ring enters into the Cavity of its Superiour.

The Cartilaginous Rings of the Tracheal Artery, and of the Bronchiæ, do cover a Tunicle composed of three principal Parts. How soon you raise up one of the Cartilaginous Rings you find a Musculous Tu-

Tunicle. Its Fibres are disposed as the Fibres of the middle Tunicle of the Intestines. The Longitudinals appear first and afterwards we see the Circulars. They are placed precisely under the Longitudinals. This Carneous Tunicle covers another Tunicle which is nothing but an assemblage of small Glandules, even as the Carneous Tunicle of the Stomach does immediately cover the Glandulous. And in fine, under this Glandulous Tunicle there is another, which is nothing but a Texture of Tendinous Fibres which come from the Carneous Tunicle; There are some Filaments of Nerves, and some small Arteries and Veins.

In the Lungs the Tracheal Artery is divided into many branches. These branches are again divided into many branches, and these again into many others, and so onward till the last end into an infinite number of small Vesicles. These Vesicles do compose the substance of the Lungs.

The Vesicles which are gathered about one end of the Bronchiæ are all encompassed

passed with one Membrane. This Membrane is nothing but the continuation of the outer Tunicle which covers the Tracheal Artery and the Bronchiæ. It is these parcels of the Lungs thus distinguish from one another by the small Membranes which enfold them, that they call the Lobuls of the Lungs.

These Lobuls are all fastned to large Trunks of the Bronchiæ as grapes to the stalk of the Cluster. It is from these Trunks of the Bronchiæ that the small branch proceeds whose Capillary branches end in their Vesicles. The Lobules are likewise joyn'd together, by small Tendinous Filaments, which keep their Tunicles contiguous. Therefore to discern them well they must be separated with the point of a Pen-knife.

The Bronchiæ are every where accompanied with Arteries and Viens. So we need only trace the Bronchiæ to discern the course of these Vessels. By this means we find that their Extremities are spread into the Coats of the Vesicles, which compose the substance of the Lungs. And

And for that the Bronchiæ are also accompanied with a Nerve which follows all their Ramifications, and is lost into the Vesicles of the Lungs; and in that the inner Tunicle of the Bronchiæ is composed of Tendinous Fibres, in all appearance the Vesicles of the Lungs are made of nothing but a Texture of Tendinous Fibres, Filaments of Nerves, some Arteries and some Veins.

When we blow into the Trachæal Arterie the whole mass of the Lungs swells, and all the Vesicles are fill'd with Air. From whence I conclude that there is a communication between the Bronchiæ and the Vesicles. And since we see that the Tracheal Artery communicates with the outward Air by the Mouth and the Nostrils, we may with reason conclude that all this apparatus of the Tracheal Arterie and the Bronchiæ has been made for conveying of the External Air into the Vesicles of the Lungs.

But because we find that the Longitudinal and Circular Fibres of the Tracheal

Arterie

Arterie and the Bronchiæ, cannot by their action but shorten the Bronchiæ and render their Cavity more narrow, we are obliged to think that the External Air is thrust out of the Vesicles of the Lungs. But since they are not made but for receiving of it, it appears that it re-enters as soon as it has gone out, and that it gets out as soon as it has re-entred, and that it continues thus to go in and get out, so long as the Animal is in Life. And it is this Ingress of the Air and its Egress from the Lungs, which they call *Respiration*.

After we have thus examined the Structure of the Lungs, we have found indeed the force which thrusts out the Air, when it is entred into the Vesicles; but we do not perceive what may be the force which makes it re-enter there. This makes me think that that force which doth press the Air into the Lungs, is not to be sought for in the Lungs themselves, but in some other part.

In searching what this force may be, I consider that the Lungs are shut up in a large

large Cavity which they call the *Breast*, and that the Breast is so closely shut up on all sides, that the Air cannot get into it but by the Tracheal Artery. By this I perceive that if the Breast dilate it self it will press the outward Air into the Lungs, to fill the place, which the sides of the Breast do abandon, in the time that it enlarges its self. After the same manner that the external Air is thrust into the Cavity of a pair of bellows, according as you raise their Boards.

Indeed we find that the Air enters into the Lungs according as the Breast is enlarged, and that it gets out as it is straitned. But because it may be enlarged for that the Air enters into the Lungs, and it may be diminished for that it gets out, we must examine the structure of the Breast, that thereby we may find how to determine.

The

The seventeenth Discourse,

Of the Breast.

THe first thing I meet with in examining the Cavity of the Breast, is a very slender Membrane which covers it on all sides, and which the Anatomists call the *Pleura*. This Membrane is doubled on the middle of the Breast. It extends its self thus from the top of the Breast to the lower part of it, it divides it into two parts, of which the one is on the Right, the other on the Left side. They call this separation the *Mediastinum* or *Midriffe*.

Without the *Pleura* are the Ribs. They are inserted on one side into the Vertebraes. They are bended in form of a *Parabola*, and are united by a Cartilaginous knot, to a Bone which covers the fore-part of the Breast, and which they call the *Sternum*. The Ribs touch one another towards the Vertebraes. They are separated according as they advance toward the *Sternum*. The space

ſpace which they leave between them is all fill'd with Muſcles, which keeps them united to one another. The firſt which appear are eleven in number. They derive their Origine from the top and the bottom of each inferiour Rib, and aſcending obliquely from behind to the Fore part, they draw the Superiour Rib to the Inferiour. They are called the Inner Intercoſtal Muſcles.

Beyond the inner Intercoſtals, there are eleven Muſcles, which they call the outer Intercoſtals. They ariſe all from the Inferiour and outer part of each Superiour Rib, and are obliquely inſerted in the fore-part unto the Superiour and outer part of each inferior Rib. Their Fibres croſs thoſe of the inner Intercoſtals, in form of a Burgundy Croſs.

Theſe Muſcles cannot ſerve by the contraction of their Fibres, but to approach the Ribs towards one another. But for as much as the Ribs are ſo ſituated that they cannot approach one another- but the Cavity of the Breaſt muſt be enlarged, we con-

conclude that the use of the Intercostal Muscles is to enlarge the Breast, by drawing the Ribs upward.

The External Intercostals are covered with many other Muscles. We observe amongst the rest one of them which comes from the *Os Sacrum* and the Thorny *Apophyses* of the Loyns, and is inserted into the upper Ribs near their Roots. It gives to each one of them a double Tendon. They call it the *Sacro-Lumbar*, when it acts it removes the Ribs from one another by drawing them downward.

There is after this another, which derives its Origine from the middle of the *Sternum*. It is fastned to the Cartilages of the true under Ribs, and to the second and third of the bastard ones. They give it the Name of the *Triangular Muscle*.

After this appears a great Muscle large enough, which arises from the inner Base of the Homoplate, and is joyned to the five true inferiour Ribs, and to the two bastard inferior Ribs by five Tendons which resemble the Teeth of a Saw. It is for this

that

that they Name it the Great Teethed Muſcle. And when it acts, it draws all the Ribs towards the *Homo plate* to which it ſends the Tendons.

Then when we go back towards the top of the Breaſt, we find a Muſcle which derives its Origine from within the Clavicle near the Acromion, and is faſtned to the firſt Rib near the *Sternum*. Its uſe is to draw the firſt Rib upwards towards the *Clavicle*. They call it the *Subclavian*.

We find alſo another Muſcle which comes from the Thorn of the three Inferiour Vertebraes of the Neck, and the firſt of the Back. It is terminated by digitation into the three or four upper Ribs They call it the upper ſmall Teethed Muſcle. It draws the Ribs into which it is inſerted upwards towards the Neck.

In fine, there is yet one which ariſeth from the three Inferiour Vertebraes of the Back and the firſt of the Loyns It is inſerted into the three or four Inferiour Ribs by digitation. It draws outwards the Ribs into

which it is inserted. They call it the Inferiour small Teethed Muscle.

The Ribs are so disposed that they cannot be moved upwards without enlarging the capacity of the Breast. And since the four last Muscles of which we have spoken do draw the Ribs upwards, we may truly affirm that their use is to enlarge the Breast, and the use of the others to diminish it.

The Breast is shut up below by a musculous wall, which they call the Diaphragm. This wall is not alwayes bended. This may appear, in that when the Animal is dead, it is Convex towards the Breast, and concave on the other side. So by its Convexity it takes up a part of the capacity of the Breast.

Its figure is almost round. We remark in it two essential parts, the Carneous and the Tendinous. The Tendinous occupies the middle. It is Transparent and woven of Tendinous Fibres and Nervous Filaments. The Carneous part encompasseth the Tendinous. It extends its self to the *Sternum*, to the Ribs, and to some

Ver-

Vertebra's of the Back, as well as to some of those of the Loins. It is strongly fastned to all these parts. Its Fibres go in a straight line from the Tendinous part, even to the places of their Insertion.

From whence we may easily conclude that when the Diaphragm acts, the Carneous Fibres by their Contraction draw the Tendinous part towards the sides. So they make the Diaphragm lose its Convexity. And since that thereby it leaves the place which it occupied in the Breast, this Cavity is considerably enlarged. Which makes us judge that the Diaphragm serves by its action to enlarge the Cavity of the Breast.

The Diaphragm is brought down also by the action of the Muscles which make the Ribs move upwards. The reason is that the Ribs cannot move after this manner without drawing the Diaphragm by its Extremities, which must of necessity make it lose its Convexity.

We find therefore by the search that we have made into the whole Breast, that it is composed of certain parts which do en-

large the Cavity of it, and of other parts which do diminish it. This makes us know so evidently the way how the Respiration is made, that we cannot almost doubt but that it is performed after the manner that we are going to explain.

The eighteenth Discourse.

Of the Respiration.

WE distinguish two times in Respiration. The time of the entry of the Air into the Breast, they Name it Inspiration; and the time of its going out, which they call Exspiration. The Inspiration is made, when the *Subclaviar*, the Great, the two small Teethed, and the Intercostal Muscles do together draw the Ribs upwards. The Diaphragm is extended also at the same time by the rising of the Ribs which draw it by its Extremities, and by the Spirits which do then run into its Fibres. So the Cavity of the Breast is enlarged

lunged and the external Air pressed by the Walls of the Cavity of the Breast. It cannot move then but on the side where it meets with the least resistance. It finds none at the entry of the Tracheal Artery, and it rencounters every where else. Where it enters, it gets into the Bronchiæ, from hence it passes into the Vesicles of the Lungs It blows them up as much as is needful for them to occupy as much space as the Walls of the Breast do abandon. Even as the motion which is given to the two Boards of a pair of Bellows when they are raised from one another, does thrust as much Air into the Bellows as is needful to occupy the space which the Boards of the Bellows have left.

By this means the Muscles which serve to draw down the Ribs have their Fibres extremely stretcht to the length. The Fibres of the Musculous Tunicle of the Tracheal Artery and of the Bronchiæ, are also greatly stretcht. Both the one and the other by their spring do rebound. The Nerves send some Spirits into their Cavity.

They are shortned. By this Contraction the Ribs are forc'd downward. The Cavity of the Breast is diminisht, and the Cartilages of the Bronchiæ do re-enter into one another. So the Air which the Vesicles of the Lungs did contain is so prest that it goes out. It passeth from the Vesicles into the Bronchiæ, from the Bronchiæ into the Tracheal Artery, and from thence out of the Body. And it is this going out of the Air from the Lungs, which is called Exspiration.

Since Respiration is no other thing but Inspiration immediatly followed by Exspiration, and this Exspiration followed as quickly by a new Inspiration, and so forward; we may very well affirm that Respiration is made by means of the Muscles of the Breast, of the Diaphragm, of the musculous Tunicle, of the Tracheal Artery and of the Bronchiæ. These Organs act successively. And the action of the one hinders the action of the other. From whence we conclude that we may in reason consider them as Antagonist Muscles.

All

All the Blood which passeth through the right Ventricle of the Heart, goeth from thence into the Lungs, and the Lungs receive the External Air into their Vesicles. So we have ground to think that this Air produceth some change in the Blood which passeth through the Lungs.

We remark indeed a great difference between the Blood which enters into the Lungs, and the Blood which goes out of them. That which enters by the Pulmonary Artery is of a Red passably deep, whereas that which returns from the Lungs by the Pulmonary Vein is of a bright and fluid Red.

Behold a very considerable change which befals the Blood in passing through the Lungs. This change cannot be made but by the Air which blows up their Vesicles, and by this means presseth the small Arteries, and the small Veins which are spread there. This pressure doth mingle more exactly the Principles of Blood and does oblige it to run more quickly into the branches of the Pulmonary Vein, to go

from thence into the left Ventricle of the Heart.

But because this exact mixture of the Principles of the Blood and this passage from the Arteries into the Veins, is not capable of producing the change that we have remarked; it must needs be that some Principle of Air extremely subtile, mingles with it. This Principle may pass through the Pores of the Arteries, and insinuate it self among the parts of the Blood.

That which makes the thing yet more probable is, that the Blood which is exposed to the Air acquires a surface extremely Red and of a colour like to that of the Blood which comes from the Lungs by the Pulmonary Vein. By which we see that the Air produces in the Blood a bright and florid Red by being mingled with it.

Since therefore the Air does produce this effect, we cannot in reason doubt, that the change of colour which befals the Blood in passing through the Lungs, comes from the Air which swells its Vesicles.

All the difference which is between the Blood

Blood of the Veins and that of the Arteries, is the same with that of the Blood which enters into the Lungs, and of that which comes from them. So we may truly affirm that this difference is made in the Lungs and not in the Ventricles of the Heart, where the Blood does not receive any alteration. For if you take Blood out of the *Vena Cava*, and afterwards out of the Pulmonary Artery, you shall find no difference between these two Bloods. Nevertheless that which is taken out of the Pulmonary Artery has past through the right Ventricle of the Heart. After this if you take of the Blood of the Pulmonary Vein and afterwards of the Aorta, you shall see that these two Bloods are alike in all things, though the one has been taken at its entrie into the left Ventricle of the Heart, and the other at its going out.

It remains as yet to examine what are the principles of Air which produce the change that the Blood contracts in passing through the Lungs. When we consider the Air narrowly We find amongst many prin-

principles which compoſe it, a Nitrous Spirit ſpread through all its Maſs. There are in Phyſick and Chymie a prodigious number of Experiments, which render the thing certain. And becauſe the Spirit of Nitre does produce in the Blood the ſame change with the Air, we have ground to think that the change which the Air makes in the Blood as it paſſes through the Lungs, proceeds from the Nitrous Spirit of the Air its mingling with it.

The Spirit of Nitre is compoſed of Acids and Alcalies. The Alcalies do rarifie the Sulphurs of the Blood, and the Acids ferment with its Volatile Alcalies. The Blood becomes thereby more ſubtile, more agitated and more rarified.

From all this we may conclude that the Reſpiration ſerves to make the Blood paſs from the Pulmonary Artery into the Pulmonary Vein, and to keep up the fermentation of it by means of the Nitrous Spirit which mingles its ſelf with it. And ſince this Spirit heightens the Red colour of the Blood, it may be alſo ſaid that the Reſpiration

ration ſerves to maintain it, and that by its means the Lympha and Chyle which do mingle with it, take by degrees its Colour and Nature.

The nineteenth Diſcourſe.

Of the Spleen.

WHen we follow the Blood, which goes out of the left Ventricle of the Heart, we find that the firſt Entrail of thoſe which we have not yet examined, to which it goes, is the Spleen. It is of a red Colour, of a conſiderable bigneſs, plac'd in the lower Belly, on the left ſide, and a little lower than the Liver.

In the Spleen there is an Artery and a Nerve, which do enter into it in Company, and a Vein which goes out at the ſame place. Theſe Arteries end in little Membranous Cells, whoſe Figure does nearly reſemble the Leaf of the Fearn. The Vein derives its Origine from the ſame Cells.

This

This appears when we blow into the Artery, or the Vein, for the Breath passeth into the Cells.

These Cells are all filled with small Glandules heaped upon one another, like the Raisins of a Cluster of Grapes. These Glandules receive small Branches of Arteries from the Trunck of the Splenical Artery, and Nervous Filaments from the Nerve which enters with the Artery into the Spleen. From each heap of these Glandules there goes a root of a Vein, which being united together, do compose the Splenick Vein.

On the Surface of the Spleen we perceive many Lymphatick Vessels, which do empty their Lympha into Pecquet's Reservatory.

By all that we have said, it appears, that nothing enters into the Spleen, but the Animal Spirits which come by the Nerves, and the Blood which comes thither by the Arteries. There goes nothing out also but the Lympha which runs by the Lymphatick Vessels into the Reservatory of the

Chyle,

Chyle, and the Blood which goes by the Splenical Vein. The Lympha is nothing but the Remains of the Nutritive Juyce of the Spleen, and it appears not to have any other quality in this place, than what it has every where else. As for the Blood, it has the same colour and consistence which we observe in other Veins

These Observations do extremely perplex us as to the use of the Spleen. For if the Arteries do bring unto it Blood, it may be said, that this is but to nourish it, and if the Nerves do bring thither Animal Spirits, this is but to give unto the Nutritive Juyce, the fluidity that is needful So that we find nothing yet but what simply serves to the Nourishment of this part.

Yet we cannot say that it is entirely useless. For what appearance is there that an useless part should alwayes be found in the Animal Body, even of the same frame and in the same situation Nature, it is like, would not have been so exact in this matter, if it served for nothing So that it is probable it has in the Animal Oeconomy some use which we do not know. But

But for that on such occasions we must be satisfied with conjectures till we find better, we may suppose that a ferment distils from the Vesicles of the Glandules and that it mingles with the Blood which passeth through the Spleen. That the nature of this ferment is such that it disentangleth from the other parts of the Blood, the parts which are proper to compose the Bile.

The reason which makes us of this opinion, is that all the Blood which goes from the Spleen passes into the *Vena Porta* and from thence goes to the Liver, where we know it rids it selfe of those parts which are fittest to compose the Bile. But this sentiment, though the most probable, has many difficulties.

All know that an Animal can live many years after the taking out of the Spleen, but this sayes nothing as to its use or Inutility; since the cutting out of the Pancreas, whose uses are known and which is acknowledged to be most necessary for the maintaining of the Animal Oeconomy, does not hinder a Dog from living many years. The

The Twentieth Discourse.

Of the Reins, and the Ureters.

THere are in the lower Belly two Bodies made like to French beans plac'd upon the loins, on the two sides of the descending Aorta, and the ascending *Vena Cava*. These Bodies receive Arteries from the Aorta, they call them Emulgent Arteries, and they send Veins to the *Vena Cava*. They call these Veins the Emulgent Veins. And these Bodies are called the Reins.

We find them first wrapt up in a Tunicle which covers the whole Cavity of the lower Belly. Next to this there is another Tunicle which does immediatly cover them. And in fine, when we have taken off these two Tunicles we discover the surface of the Reins, upon which we have the pleasure to observe an agreable ramification of Sanguineous Vessels.

These Sanguineous Vessels do enter into

to the Reins upon there Concave side which looks towards the Aorta and the *Vena Cava*. Many small Nerves go from the *Plexus Renalis* and bear them faithful Company. They are all shut up in a small Membranous Cover, and the Nerves are lost in its substance. Afterwards these Vessels are spread through the outer substance of the Reins and enter into small Glandules, of which this whole outer substance is composed.

These Glandules are tastned to the Vessels as the Grapes to the Trunk of the Cluster. By this means they make small Lobes wrapt up into a particular Tunicle. This Tunicle enters partly into the Capsula, and partly into the Cavity of the Reins, which they call the Bassin. All these small Lobes do adhere to the one or the other of these by small Tendinous Filaments.

From each Glandule there goes an Excretory Vessel. They descend in a straight line to the Bassin, being coucht one beside another. When they come near to peirce the Tunicle which makes its inward Cover,

Cover, many of them joyn together and make up a great Pipe. This Pipe has an opening by which it communicats with the Bassine, about which opening we remark a little Rising, which they call a *Papilla*.

The Cavity of the Bassin is Covered with a very thick Tunicle. It is formed of the Expansion of the small Pipes which pierce it. It is afterwards so much contracted towards the Concave side of the Reins, that it takes the forme of a Vessel of the bigness of a Goose feather. It descends in the forme of an S, and goes into a Bag placed in the lower part of the *Abdomen*, under the Pecten. They call this Bag the Bladder of the Urine.

These Vessels they call the Ureters. They are wrapt up in the *Peritonæum*, and in a proper Tunicle, which communicates with that which does immediately cover the Reins. Their Substance is Membranous and very Thick. Their Fibres are so variously interwoven that they keep no order.

The use of the Reins is to separate a Salt-ish Serosity from the Blood, which passeth from the Glandules into the Bassins, and from thence runs by the Ureters into the Bladder. This Liquor they call *Urine*.

The twentieth and first Discourse.

Of the Bladder, and of the Urine.

THe Bladder is a Bag into which all the Urine goes, which the Reins do separate from the Blood. Its Figure is like to that of a Pear. It is so Situated, that its wider part, which they call the Bladder, is alwayes turned upwards, and its more narrow part, which they call the neck of the Bladder, is ever turned downwards.

It is held in this Situation by two considerable Ligaments. The first goes from its bottom to the Navel: It hinders it from falling downwards. The second is very short. In Men it keeps it fixt upon the

Rectum

Rectum, in Women upon the *Matrix*, so that the Bladder cannot turn either to the left or right Hand. The first is inserted in its fore part, and the second in its hinder part.

The Bladder is made up of three Tunicles. The first is nothing but a production of the *Peritonæum*, which enwraps it outwardly. It is composed of Tendinous Fibres variously interwoven. The middle Tunicle is made of Carneous Fibres. Of these they reckon three Orders. The first is of some great Fibres coucht on the fore-part of the Bladder, which come in a straight line from its bottom even to its neck. The second is of Fibres which do enwrap the Bladder Circularly. They may be called Circular Fibres. And the third coucht under the Circular, is of Fibres which cross the former obliquely, going from the left to the right Hand, from the bottom of the Bladder even to its neck. We shall call them Transverse Fibres. In fine, the inner Tunicle is composed of Tendinous Fibres, of

such a Texture as has not been yet discovered. When the Bladder is not blown up, it is all wrinkled, and within it is alwayes covered with a Mucilage. At the neck of the Bladder there is a Muscle made of strong and Circular Fibres. It is a *Sphincter* which keeps it alwayes shut.

From all this we may conclude that the Bladder is a Concave Muscle, whose outer and inner Tunicles are Tendons, and the middle Tunicle, the Belly.

The Insertion of the Ureters into the Bladder, shewes evidently enough that its use is to be the Reservatory of the Urine, and that all we have remarked in its frame, tends to no other end but to keep the Urine in its Cavity, and to thrust it forth when it is therewith filled.

I say that the Bladder is the Reservatory of the Urine, for that the Ureters are inserted into its Cavity after such a manner, as that the Urine can easily enter there, but cannot return again into the Ureters. They creep for some space betweeen the outter and middle Tunicles, afterwards they

they peirce the middle Tunicle, and creep a little farther between it and the inner, which they peirce towards the neck of the Bladder. So the Urine can pass without much difficulty from the Ureters into the Bladder. But as the Bladder swells by the abundance of Urine it straittens the ends of the Ureters which creep amongst its Tunicles, so that the Urine in the Bladder cannot enter there.

The *Sphincter* of the Bladder is the cause that the Urine makes some stay in its Cavity. And least in staying there its salts should prick the inner Tunicle, nature has conveyed thither the Mucilage which anoints it on all sides.

The Longitudinal Fibres shorten the Body of the Bladder when the Animal Spirits do contract them. The Circular and the Transverse do by their action straitten it. So when the Fibres are filled with Spirits the Bladder is Lessened in all respects. And if then there be Urine in its Cavity, it makes its passage maugre the resistance of the *Sphincter*, and gets out

of the Body by a small Pipe which they call the *Urethra*.

This Pipe is nothing but the Continuation of the Inner Tunicle of the Bladder. In Women its opening is in the *Pudendum*, and in Men it extends its self into the Body of the Wand, and terminates in the end of the *Balanus*.

By all that has been said we see that the Reins, the Ureters, the Bladder and the *Urethra*, have been made to separate the Urine from the Blood, and to convey it out of the Body, not only as useless, but even as hurtful to the maintaining of the Animal Oeconomie.

To understand these truths aright, it is to be observed that the Urine is almost composed of nothing but Phlegms and Volatile Salts; having but very little of Sulphur, Earth, and fixt Salt.

The Nitrous Spirit which mingles with the Blood in the Lungs is composed of Acids and Alcalies. Its Acids coming to joyn with the Alcalies of the Blood do make a Salt. And for that the most part

of

of the Alcaline parts of the Blood are Volatile, the Salt which is made of them is also Volatile. These Volatile Salts might diminish the natural Fermentation of the Blood and stop its Course. To prevent this mischeif, the Author of Nature has plac'd the Reins into the Bodies of Animals, which do separate these Saline parts from the Masse of the Blood. And for that also a too great abundance of Phlegm, would make the Blood too slow and hinder the Spirits from acting, the Reins do not only separate the Salts, but also the Phlegms, which are the two Principles whose too great abundance would be capable of chocking the ordinary Fermentation of the Humours, upon which the life of Animals depends.

Moreover it is remarked that when the Urine abounds in Alcalies, that is to say, when its Salts are not strongly charged with Acids, it is thick and troubled. And when it has a deal of Acids, that is, when its Salts are well furnisht with them, it is more clear and Transparent. And when there is much

Salt

Salt in a little Phlegm, the Urine is of a reddish Colour. And when there is much Phlegm and little Salt, it is clear, and is very near unto the ordinary Colour of Water. To

There is remarked in the Urine a little Cloud, which is formed of some parts of the Mucilage, which we have said is in the Bladder. The Salts of the Urine detach them by little and little, and carry them along with them. This Cloud appears when the Urine begins to cool, because the moisture doth condense it, and by this means renders it more visible.

FINIS.